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ROCK DRILLS AND DYNAMITE WERE USED TO MAKE THIS TRENCH FOR A NATURAL-GAS LINE EXTENDING FROM LOUISIANA INTO GEORGIA

Grand Canyon National Park's Sewage-Disposal System
M. R. Tillotson

Constructing a Hotel Under Adverse Conditions
Jean Dubois

Industrial Southeast Draws Gas From Wells in Louisiana
R. G. Skerrett

Driving a Drainage Tunnel For Coal Mine
S. G. Roberts

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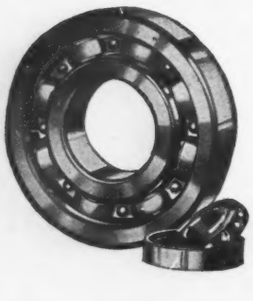
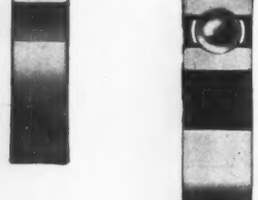
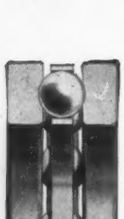
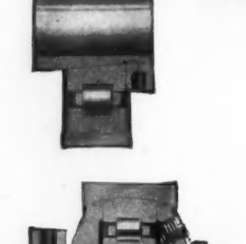
There is a PRECISION BEARING *for every* LOAD, SPEED *and* DUTY









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As It Seems To Us

UNEMPLOYMENT

SEASONAL or periodic unemployment has been an economic problem for a long, long while. For years, the peaks and hollows of the curve of employment were accepted as inevitable; and workers in many lines of wage-earning followed their respective fields of service with this understanding. With the coming of days of higher living standards, with their reflexes in many departments of business, the influences of unemployment widened and the general effect upon the well-being of the populace as a whole became more serious. How to smooth out the curve of employment has, therefore, latterly engaged the attention of industrial leaders the country over. In this line of effort the New York Building Congress is taking a notably active part.

This organization is collecting data on the employment of building-trades mechanics with a view to predetermining the probable state of the labor market in each trade. The object, of course, is to ascertain how available skilled mechanics can best be used and, on the other hand, to find out at what seasons owners and builders will most likely be able to secure competent help. With this information to draw on, building or remodeling plans can be made accordingly.

One factor bearing directly on the subject is the leasing dates within the Metropolitan area. These are usually the first of May and the first of October. Leasing dates now virtually control the completion of certain types of buildings: the stabilizing of the building trades would be brought considerably nearer if leasing dates were such that structures could be started and finished during any month of the year. Furthermore, such an arrangement would benefit those engaged in the operating and maintenance of properties of this kind.

As the New York Building Congress points out: Regularity of employment affects not only the mechanic but the architect, the builder, and the material-supply man. In the building industry, a seasonal decline in operations means an immediate cessation or slowing up of the manufacture of building materials. Consequently, every effort should be aimed towards year-round building, because it would have far-reaching and beneficial economic effects.

As is well known, building operations can now be carried forward in the coldest weather; and that despite the fact that much of the material used must be protected from the action of frost and the workmen correspondingly shielded from the rigors of the season. The example thus set by the New York Building Congress could be followed to advantage in other departments of our manysided industrial life.

OUR TOURISTS DISCOVERING SOUTH AMERICA

FOR the past three years, American tourists to Europe have annually spent in the neighborhood of $300,000,000 while abroad. This is a large sum of money, and it is easy to understand why competition for the tourist trade is becoming increasingly keen among the countries most concerned in this added source of revenue.

Much as our tourists have meant to Europe, and much as the countries on the other side of the Atlantic have done to provide attractions for those visitors, it is a fact deserving attention that South America has heretofore done but little to draw our tourists to its gates. Our southern neighbors are now awakening to a realization of what they have hitherto missed, and some of them are bent upon changing their ways and winning a part of this very profitable business.

In January of this year, Chile had 10,000 foreign visitors—most of them from the United States. Heretofore, more of our people have visited countries and ports on the east coast of South America; and this recent trend to the west coast indicates a growing appreciation of the wonders of the Andes and the historic attractions of Chile, Peru, and other Andean countries. Chile and Peru are embarking upon railway construction, the building of highways, and the amplification of conveniences generally that will appeal to the sight-seeing tourist. Greater intercourse should be reciprocally beneficial to the visitors and to the visited, and contribute to a better understanding throughout the Western Hemisphere.

KEEP A FINGER ON THE PULSE

HEAT and humidity undoubtedly make a combination likely to induce discomfort, but neither of these nor both of them need cause concern until they are responsible for a high pulse rate. This pronouncement was made recently by Dr. W. J. McCONNELL of the Industrial Health Service of the Metropolitan Life Insurance Company. In a paper read by him before a recent meeting of the American Institute of Mining and Metallurgical Engineers, the doctor described experiments made on voluntary subjects observed within cork-lined chambers in which temperature and humidity could be regulated to a nicety.

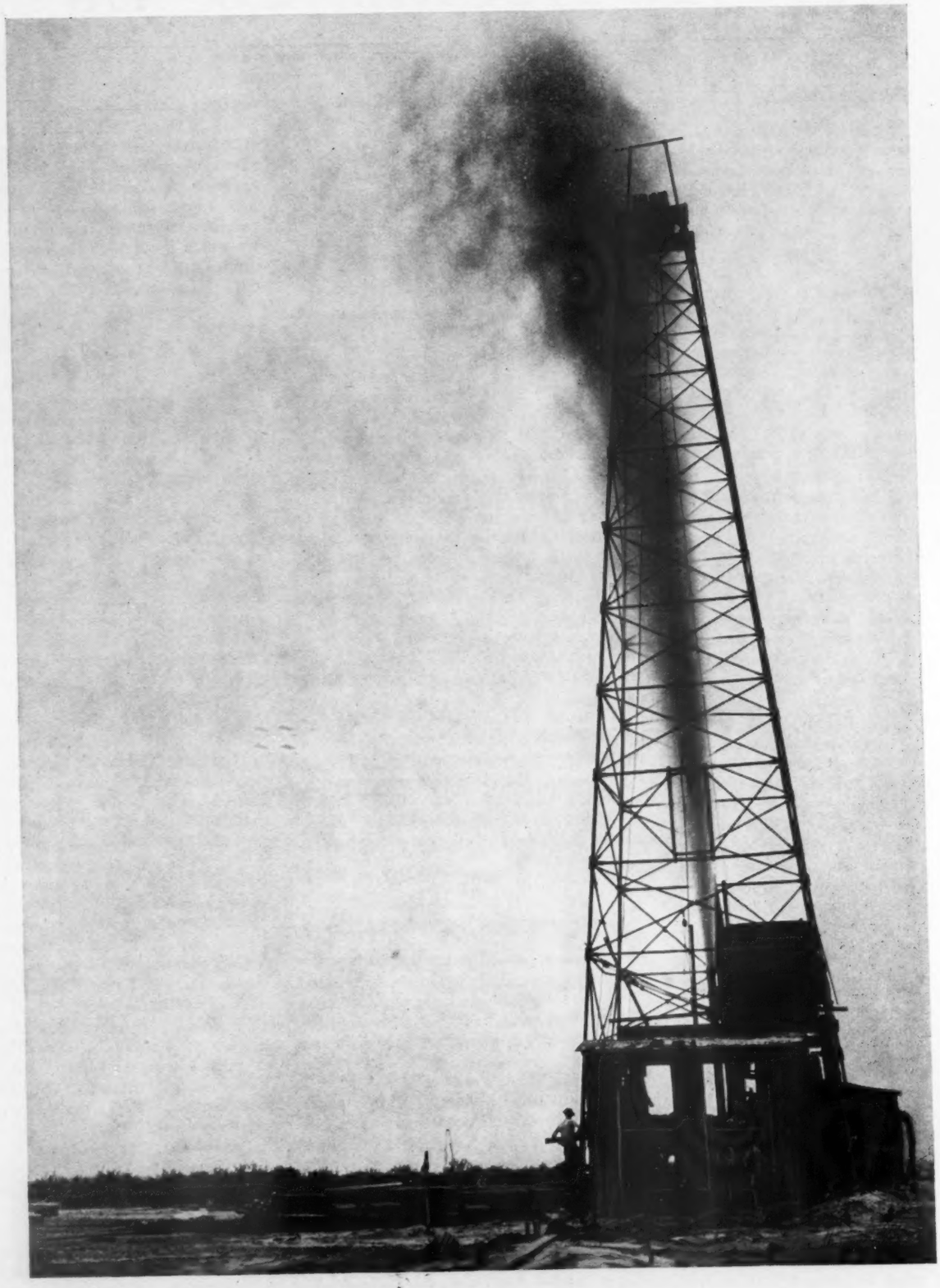
The experiments, so *The New York Times* reported, indicate that the highest temperature at which the body can compensate for atmospheric conditions is 90° F. when the air is saturated and still, and about 95° in a brisk wind. Temperatures between 40° and 75° are the most suitable for working. As the heat and the humidity rise, the body tries to keep its temperature constant. The heart pumps blood to the surface, and the skin is flushed. As the struggle of the body increases, the pulse rate increases also. The data obtained by the experiments make it possible to predict just how human beings will normally respond to certain temperatures; and means are suggested by which disadvantageous temperature conditions can be combated. We need not point out the importance of these findings nor their value, potentially, when applied in many fields of work.

A GARDEN OF EDEN

SOME day, some where, the tireless paleontologist is going to be able to tell us definitely where the Garden of Eden of the Bible was—that is, the original cradle of the human race and of all other sorts of living creatures. Until that day of certainty arrives, we shall have recurrent speculations as to the *locale* of the Garden of Eden as different centers of prehistoric life are discovered.

According to no less an authority than Dr. AMADEUS W. GRABAU, at least one such garden flourished in the remote past in what is known as the Sinkiang Basin, which lies in Eastern Turkestan to the west of the Gobi Desert, which has already yielded amazingly interesting finds. Doctor GRABAU, as reported by *The Sun*, New York, believes that a tremendous wealth of biological relics lies at a depth of possibly 400 feet under the sands and clay deposits of the Sinkiang Basin—this great overburden revealing something about the period of time that has elapsed since the creatures in question were buried there. As Doctor GRABAU expresses it: "Only American steam shovels are lacking to unearth a great mass of remains of our prehistoric ancestors, the ancestors of the recently discovered Peking Man, and probably the home of original man."

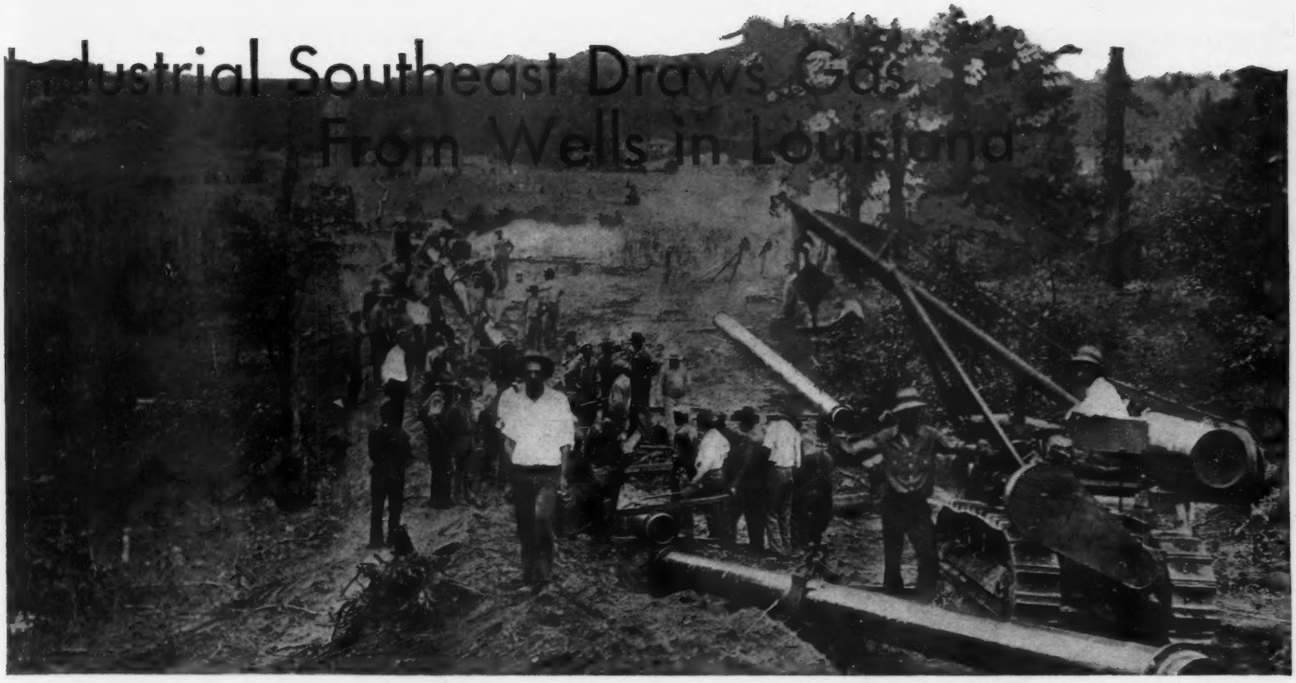
What was it that transformed that region full of life into an arid waste and made it one vast graveyard? The theory is that the once enormously expansive fertile plain had its climate abruptly altered by the titanic crustal upheaval that brought the Himalaya Mountains into being. Those mountains shut off the winds that previously had carried life-giving moisture; rainfall ceased, vegetal growths withered, and, as a consequence, animal life perished—only those creatures surviving that were able to migrate. The Peking Man was a descendant of a race that had flourished long before him in the area to the westward. These conclusions push the origin of man millions of years backward into the past and emphasize the great and radical changes that have taken place since then in the physical features of the earth. In a sense, "the immemorial hills" thus become the creations of but a yesterday.



United States Bureau of Mines

"Blowing in" a natural-gas well. Three-fourths of all the gas consumed in the United States is natural gas.

Industrial Southeast Draws Gas From Wells in Louisiana



Crawler tractor handling 12-inch pipe in assembling and laying a section of the gas line. The company doing this particular part of the work laid 90 miles of pipe and backfilled the trench in three months.

By R. C. SKERRETT

A GREAT steel artery substantially 497 miles long now links Atlanta, Ga., with the famous Monroe and Richland natural-gas fields of Louisiana. This artery, when used to capacity, will be able to convey daily from the fields to the consumers a total of 150,000,000 cubic feet of gas. In its course, this conduit traverses notably productive sections of Mississippi, Alabama, and Georgia; and penetrates to the very heart of what is commonly known as our "Industrial Southeast"—supplying on the way numerous cities and communities. The enterprise of the Southern Natural Gas Corporation is primarily responsible for this engineering achievement.

Work on the system was started in June of last year, and gas was delivered through the line to Birmingham, Ala., on December 31, following. Twenty-one days later the gas was available to industrial and domestic users in Atlanta, Ga. The wonder is that the main artery of the system—nearly half a thousand miles in length—could have been constructed within the brief interval mentioned; and that such was in fact done is evidence of a high order of coördination and of the extensive employment of mechanical equipment devised for just this sort of work.

It is befitting that the benefited consumers should realize how this thoroughly up-to-date convenience has been provided for them. More than likely only a relatively few of these are aware of what had to be overcome in making it possible to transport the gas from the wells in Louisiana over hundreds of miles of changing country and to cross on the way no fewer than eighteen rivers and a number of swamps. Despite the use of time-saving and labor-lightening machinery, still an army of 5,000 men was required on the job at the peak of operations. The whole program of execution has been under the direction of Ford, Bacon & Davis, Inc., as agents for the Southern Natural Gas Corporation.

This new and far-flung system for the distribution of gas typifies the modern idea of conservation of a natural resource through wise utilization. Furthermore, this conveying of natural gas from wells in the Pelican State will obviate annually the hauling and handling of more than 2,000,000 tons of coal and the incidental disposal of ashes from that volume of solid fuel. The total cost of this pipe-line system, with its compressor stations established at strategic points, will represent when finished in accordance with the present program an aggregate outlay of approximately $30,000,000.

AT an outlay of about $30,000,000 the Southern Natural Gas Corporation is bringing to completion a pipe line through which fuel is now being pumped from gas fields in Louisiana to Atlanta and other communities on the way. The main line of this system, with two feeders from the fields, has a length of 497 miles.

In addition to the main line, there are branch lines aggregating 431 miles. A series of compressor stations will be built as the service demands to boost the gas and to send it forward to the remotest points of consumption. Despite much hampering rainy weather, the work of laying the pipe line was carried forward with remarkable speed.

The building of this system has made it possible to transport natural gas into the very heart of the "Industrial Southeast", and thus to provide a highly efficient fuel for the home, the factory, and all sorts of places of business.

In addition to the 497 miles of main line and two feeder lines tapping the Monroe and the Richland fields, the system will include a matter of substantially 431 miles of branch lines, composed of piping of smaller diameters than the piping forming the main line. In other words, the system now in hand will have, when completed, a combined length of 928 miles. Before describing the installation in greater detail and the ways and means employed in building it, we shall deal briefly with the Monroe and the Richland fields.

In 1916, a well—the first of many—was drilled in the Monroe Field in quest of oil. When the tools penetrated to a depth of a little more than 2,000 feet below the surface a voluminous flow of gas was obtained, but no oil. At that time there was no local market for the gas, and the fuel went to waste until the year following when the carbon-black industry established itself there to take advantage of the cheap and abundant gas. Carbon black is made by directing a gas flame against a metallic surface, an adaptation of the smoking lampwick—the accumulating soot, as most of us would call it, constituting the carbon black of commerce. Carbon black serves many purposes and is used in large quantities. It is employed in the manufacture of automobile tires and in the production of many other forms of rubber. It is also utilized in the making of printer's ink and in turning out a wide variety of commodities in daily service. Until recently, gas from the Monroe Field was consumed principally in the pro-

1—Where the pipe line crosses a cotton field. A mechanical backfiller at work scraping earth into the trench and on top of the laid pipe. 2—A sharp turn in the pipe line on a hillside not far from Birmingham. 3—Buckeye wheel-type ditcher digging the trench for a 12-inch section of the pipe line in the Birmingham district. It can trench at the rate of 21 inches a minute.

duction of carbon black—a use that is warranted only when no better market is available for such a fuel.

Ten years after the discovery of gas in the Monroe Field, the first producing gas well was drilled in the Richland Field, about twenty miles away in the same northeastern corner of Louisiana. The wells in the Richland Field have a rock pressure of from 800 to 1,000 pounds, while the pressure of the gas in the producing rock or sand in the Monroe Field ranges from 400 to 900 pounds. The Richland wells are also distinguished because of their large capacities. According to the estimates of competent geologists, the two fields have in reserve a combined volume of approximately 3,377,000,000,000 cubic feet of gas. This figure—incomprehensible to most of us—indicates to the experts that there is enough natural gas remaining in the sands at present tapped to meet existing and prearranged demands for a period in excess of fifteen years to come.

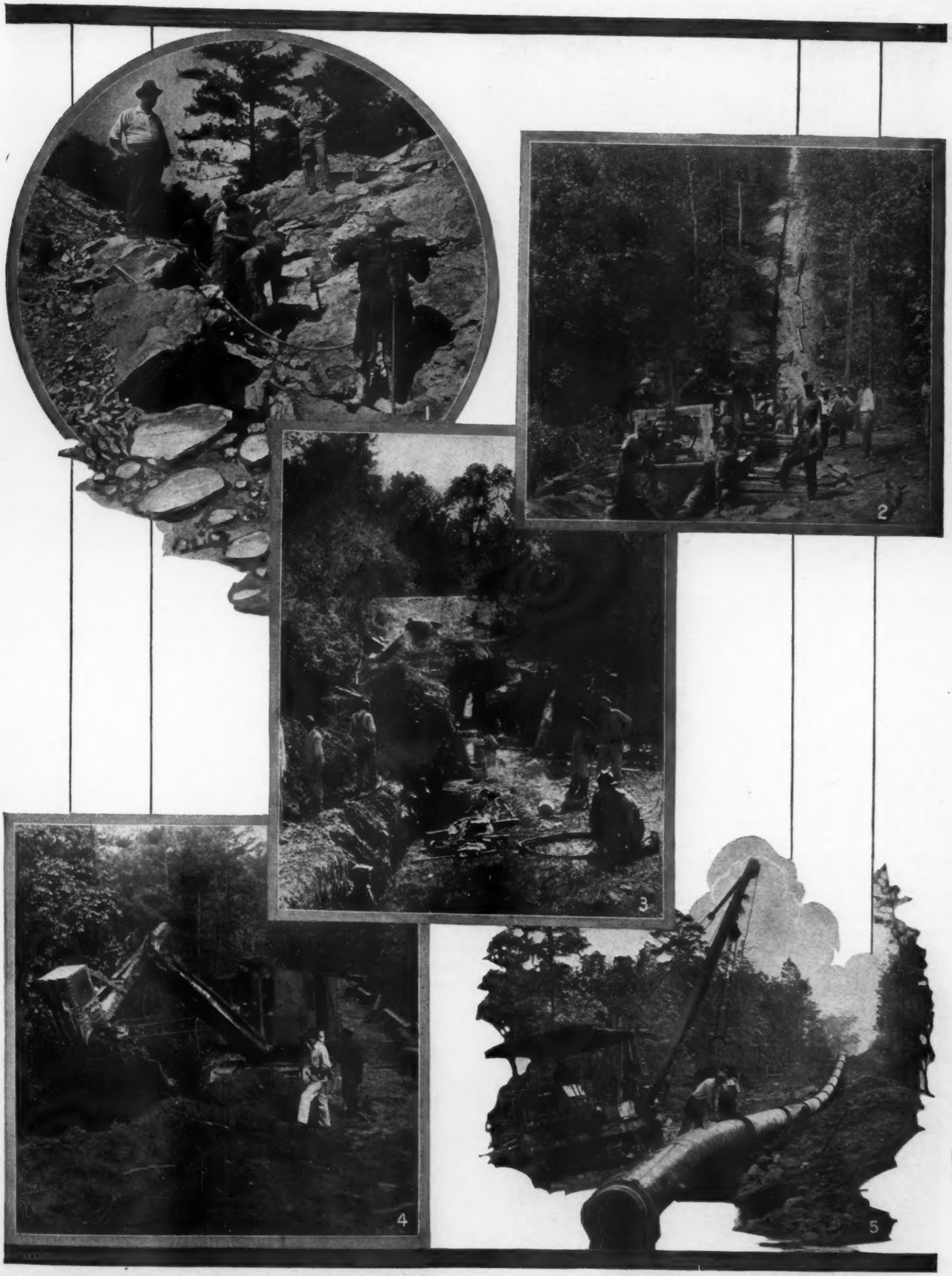
The burning of natural gas in the making of carbon black becomes uneconomical when the gas can be carried to other more profitable industrial and domestic markets. Because the Louisiana fields are now supplying gas to distant users, the carbon-black producers are gradually shifting their plants to the Panhandle of Texas. This movement has a direct bearing upon the probable service life of the Monroe and the Richland fields. In addition to this fact, exploratory drilling has revealed another gas-bearing sand 200 feet below the one that is now furnishing gas in the Monroe Field; and this warrants the reasonable assumption that the whole area holds a good deal more gas than the geologists have so far stated as a dependable minimum.

The curious will ask: "Why should sections of the Industrial Southeast turn to Louisiana for natural gas when they have near by ample supplies of coal from which to manufacture gas?" The answer is: The value of a gas for fuel is primarily determined by the measure of its thermal units—commonly expressed as B.T.U's—in a given volume, and then by the ease or efficiency of its practical application. Thousands of years ago, Nature in her laboratory, as represented by the Louisiana sands, produced an exceptionally pure gas and one that contains about 1,000 B.T.U's—twice as many as does the gas manufactured by man under the best conditions that he has been able to devise. Therefore, this natural gas, in addition to its greater number of thermal units per volume, will make it possible to obtain substantial operating economies.

This deep ditch eases the pipe line over the crest of a hill. Pipe in place and ditch ready for backfilling.

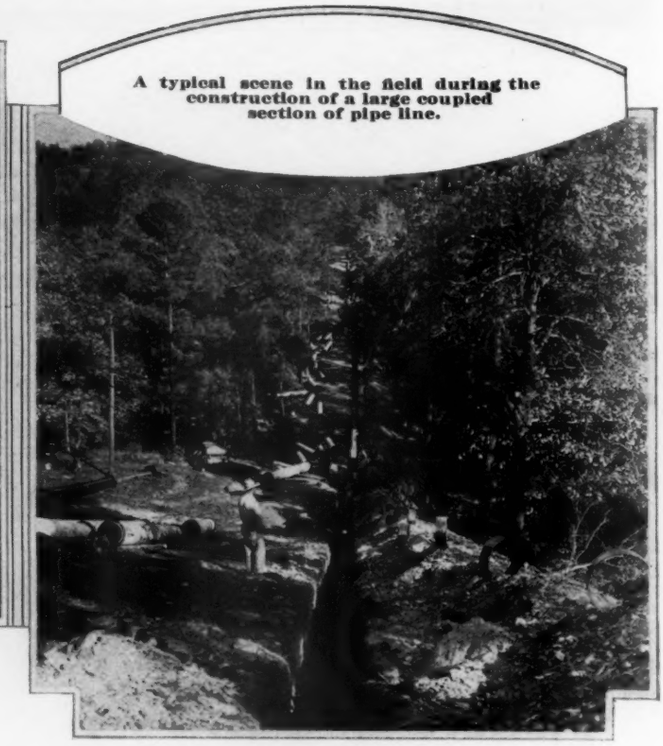
Gas, besides being one of the cleanest of fuels, is especially suitable as a source of heat in all lines of manufacture wherein a more or less close control of temperatures is essential. Not only that, but gas—because of its very nature—is adaptable and can be handled with relative precision in either large or small quantities. That is to say, gas can be used just as successfully and effectually in the melting of many tons of metal as it can be controlled and employed in the tiny blow torch of the jeweler. By using gas instead of coal, for example, the bulk handling of a solid fuel, its storage, and the disposition of its ashes can be obviated.

The Industrial Southeast embraces the states of Tennessee, North and South Carolina, Alabama, Georgia, and Florida; and within this region, rich in natural wealth, industry is developing at a rate more than 25 per cent faster than the rest of the nation as a whole. During the 12-year period from 1914 to 1925, inclusive, the value of manufactured products in these six states increased in excess of 200 per cent as



1—Where "Jackhamers" did their bit in digging an "overbend" trench at the crest of a hill. 2—Horses in position and lowering a section of assembled 12-inch pipe line into a trench in rough country. 3—Where the pipe line dives under a stream and goes below a railroad that crosses the right of way. 4—Close-up of a pull-stroke type of digger at work on a division of the pipe line. 5—A long stretch of coupled line in position over the trench preparatory to lowering into the ground.

Pull-stroke ditcher used to dig a section of trench in part of Alabama. A good clean cut.



A typical scene in the field during the construction of a large coupled section of pipe line.

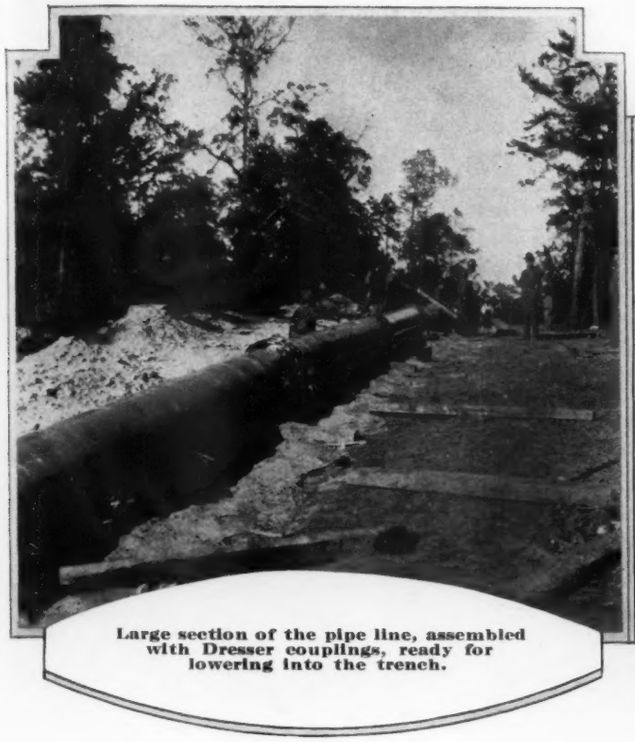
compared with an advance of something less than 160 per cent for the entire United States. Because of this rate of development, the Southern Natural Gas Corporation decided to make gas from the Louisiana fields available to the outstanding industrial communities of the territory in question, and started work to that end less than a year ago. So much for the background of our subject.

Having determined to build the line, the next step was to survey the country over which the route for the gas line would be traced. In some difficult parts of the country, photographs made from airplanes were utilized in planning the course to be followed. This is understandable when we are reminded that the pipe line crosses open country, numerous rivers and streams, marshlands, hills, and even semi-mountainous areas in linking Atlanta with the gas fields. As far as possible the line was kept nearly straight; and, to this end, natural obstacles had to be met squarely and overcome, one by one, so that the route would require the fewest miles of piping and the least amount of costly excavating.

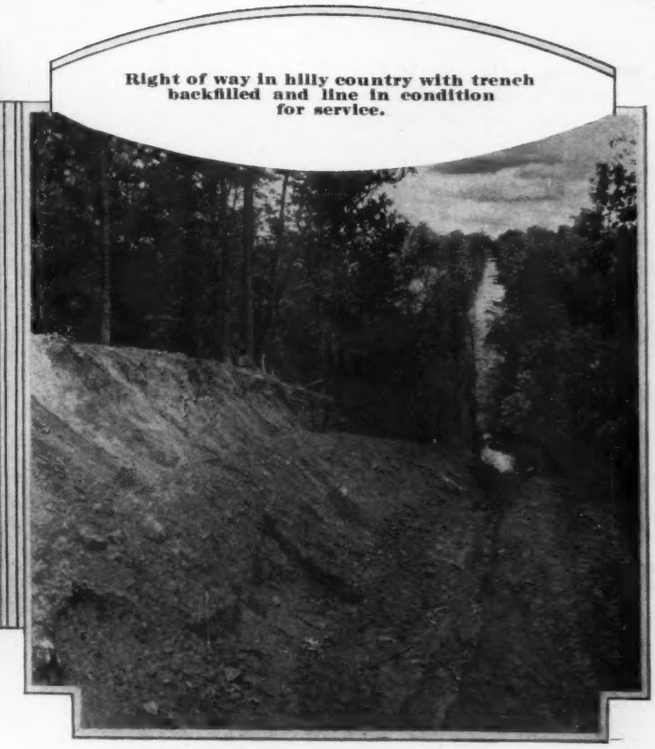
After settling upon how the line was to run, then the Southern Natural Gas Corporation had to secure a right of way over the properties concerned—dealing in this phase of the undertaking with property owners of all sorts and kinds. Some of these assented willingly to the terms offered them, while others delayed in their determination to get the very utmost for their concessions. The right of way for such a project is generally 30 feet wide so as to give ample scope for the effective employment of machinery and vehicles used in digging the trenches and in moving the piping and other equipment into position. The property owners were paid not only for the easement granted but for injury to crops or other damages occurring during the construction of the line. Here human nature again figured conspicuously; and the contractors had to be continually on the alert to safeguard themselves from fictitous or exaggerated claims.

Where the route ran over badly broken or wooded country, the right of way had to be cleared at the start and roads built to make access possible for the distribution of pipe and other equipment and supplies; and in out-of-way places camps were built and maintained for the accommodation of the working forces so isolated. Also, a private telephone line had to be strung to facilitate intercommunication from end to end of the undertaking. All these things were done far enough in advance of actual operations to insure the steady employment of the field gangs when once the ditching and the pipe-laying work were taken in hand. It was essential that the men be kept both busy and contented so as to hold the high labor turnover as low as possible.

Left—A crawler tractor, equipped with a boom and a winch, being used to lift connected sections of the pipe line on to skids, laid across the ditch, before placing in the ground. Right—Skids removed from beneath the assembled pipe and the load transferred to horses preparatory to lowering the line into the trench. With the pipe in the ditch the backfillers finish the job.



Large section of the pipe line, assembled with Dresser couplings, ready for lowering into the trench.



Right of way in hilly country with trench backfilled and line in condition for service.

A regulatory force was organized to deal with troublemakers and the unruly. This meant contending with persistent bootleggers who lost no opportunity to outwit the law as impersonated by the sheriff and his deputies. In that part of the nation a sheriff is a personage to be reckoned with seriously. He carries a gun, and he is apt to be quick on the trigger. His appearance at a camp is an "occasion" well calculated to arouse interest.

The business of building pipe lines is a well-organized one today. All hands are urged onward by an unflagging spirit of accomplishment; and, rough and ready as the work necessarily is, it is astonishing how nicely coördinated all efforts are so that there will be little if any lost motion. The construction of the Monroe-Atlanta line has been typical in this respect; and the participating contractors deserve the greatest praise for the rapid progress made in spite of prolonged periods of rainy weather that made roads virtually impassable to ordinary traffic and turned wide areas of normally dry country into veritable morasses. Conversely, when the sun shines in the South in the summertime, the mercury climbs high, and pipe exposed to the sun becomes too hot to handle. Furthermore, the heat adds greatly to the stress upon men working in the open.

The line from the Monroe Field and the line from the Richland Field converge upon Pioneer, in Louisiana; and from that point on to Birmingham the main artery of the system is composed of 22-inch pipe, and from Birmingham to Atlanta the line is made up of pipe 20 inches in diameter. The lateral or branch lines, depending upon their lengths and the sizes of the communities supplied with natural gas, range from 12¾ inches down to 3½ inches in diameter. The program will have embraced, when the last of the branch lines are finished, the digging of 928 miles of ditches—dug deep enough and wide enough to accommodate the different sizes of pipe and to insure, when backfilled, sufficient cover to protect the lines against the effects of seasonal changes and to safeguard them against the shock of crossing traffic and the reach of the farmer's plow when cultivating the overlying soil. Because the line is built to carry gas at high pressure, the minimum permissible cover is 30 inches. In numerous instances the trenches have been dug a good deal deeper—especially when crossing the crest of a hill so as to ease the arc of the overbend.

Digging the trenches has been a gigantic task; and the cost would have been prohibitive if done by hand. Fortunately, machines have been developed for this particular work; and some of them are capable of advancing at a rate of nearly 2 feet a minute when digging a ditch of the maximum required depth. They forge forward like irresistible

Left—Making a tie-in weld at the junction of two long sections of an 8-inch line. The welder is working at a bell hole where he can weld the underside of the connection. Right—Where rock is encountered in digging a ditch, portable compressors furnish the air required by the drills. Many compressors of this type have been employed along the line.

mammoths. Earth makes easy going for them, and they can jog along even through some soft shales, but they are halted by solid rock, which must be drilled and blasted small enough for the scoops or shovels of the mechanical ditchers to deal with it. In disposing of intervening rock, portable compressors and air-driven "Jackhamers" have had their part to play in helping the work along; and the numerous compressors on the job have performed a variety of other useful services.

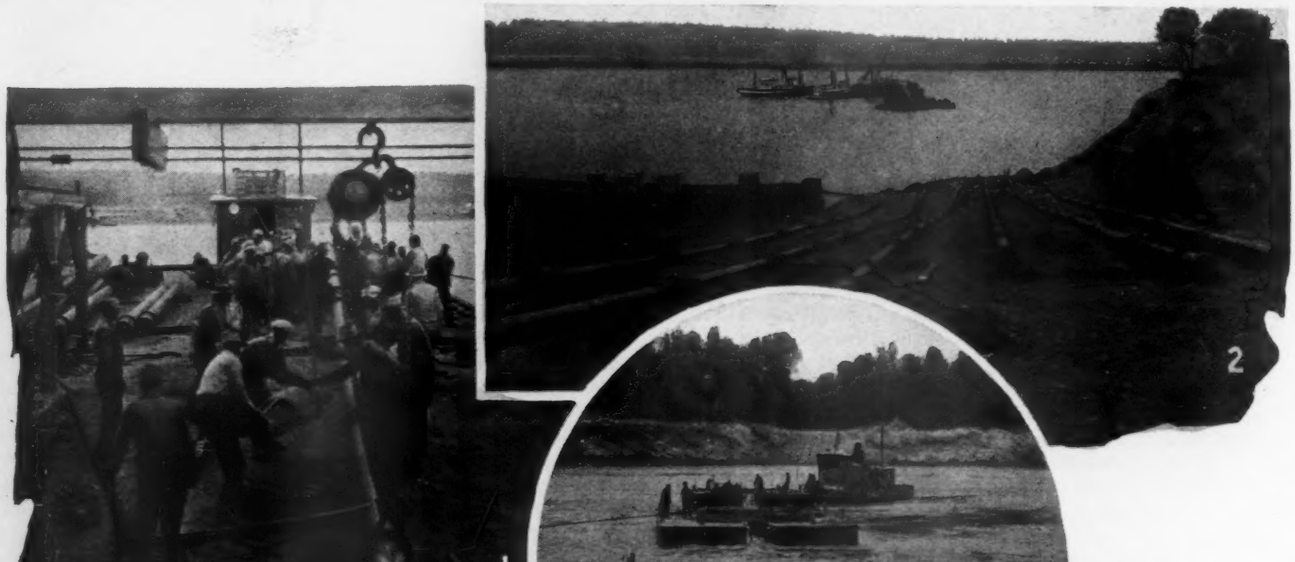
Always in advance of the digging of the ditches, enough of the required pipe has been transported from the nearest railroad siding to each operating point and then laid out along the line of the trenches to be dug. This has not been as simple as it sounds, because heed had to be taken of the contours of the country and sufficient pipe strung out conveniently near to provide a variable measure of slack in the line. Slack is necessary in order to take care of contraction and expansion due to temperature changes, especially while the line is in the course of assembly and before it is buried in the ground. The forces set up by expansion and contraction may be great enough to pull a welded line apart at the joints, and may even break a coupled joint, although this happens but seldom. All piping is given a protective coating before it is buried; and where the sections may have to remain in the sun before laying, the pipe is at times painted white so as to reflect the hot rays and thus to reduce expansion as far as practicable. Before describing the actual laying of the line it would be best to tell how the unit lengths are assembled in readiness for ditching.

The unit lengths so far used have ranged from 20 to 40 feet. The joints are being made either by oxy-acetylene welding or by couplings composed principally of a sleeve and two rings drawn together by threaded bolts against two rubber gaskets. This is known as the Dresser coupling. Depending upon the diameter of the piping, anywhere from 400 to 600 and more feet are assembled in advance of lowering a section in the ditch. In either case, the lengths to be joined are brought together and lined up to facilitate coupling or welding as required. The handling of the pipe for this purpose is done by tractors equipped with side booms. If the pipe is to be welded, each joint is spot welded at several points so as to keep the pipe in alignment. With this done, the "firing-line" welders take up their work, which consists in making roll welds—the men joining from five to nine lengths of pipe into a single string. A good welder will make four such joints in the course of a day. As a welder works, the pipe is rolled over until the entire girth is welded, and by this procedure all the welding is done virtually on top of the pipe. In tying in two strings of pipe some of the welding must be done from underneath, and shallow bell holes are dug under the joint so that the welder can do his work when it is impossible to roll the pipe over. When the firing-line welders finish joining a string they move on to another section made ready in advance for them by the lining-up crew and by the tack or spot welder. Thus operations go on without cease in assembling the line preparatory to laying it in the ditch already dug for it. As much as 8,600 feet was assembled and laid in the course of a day by one of the contractors.

No matter how the sections are assembled, when they are joined together they are rolled over by tractors on to skids placed across the trench. In the case of pipe of large diameter, the next step consists in transferring the load from the skid to wooden horses that straddle the trench; and then, by means of slings and suitable tackle, the line is lowered easily into the ground. From time to time, bends have to be made in the line either to conform to the contours of the ground or to give the line a new direction. In the larger lines the bends are made by heating the pipe and are called fire bends, while the smaller pipe sections can be bent cold after assembling. One of our illustrations shows this being done in the case of an 8-inch line.

Where gas is not available for the purpose, and under suitable pressure, assembled strings of pipe are tested by closing the opposite ends with taps devised for that service; and then air from a portable compressor is turned into the line and brought up to the required testing pressure. Each joint or factory seam is coated with soapsuds, and bubbles give visible evidence of any leak which is promptly made perfect by the welder responsible for that particular joint. This testing is done before the strings of pipe are lowered into the ditch.

In hot weather it is customary to lower the pipe into the ditch in the early morning hours when the pipe is coolest and most contracted. Even so, the pipe is not laid in a straight line but somewhat sinuously or undulating so as to provide slack that will insure the pipe being under compression in the wintertime, and certainly under compres-



1—Derrick boat on which the sections were assembled, and reinforcing clamps fitted at the joints preparatory to sliding one of the multiple lines into the Mississippi River.
2—The six multiple lines that convey the natural gas from the 22-inch main in crossing the Mississippi River where that watercourse is 3,000 feet wide and attains a depth of 125 feet.
3—Pontoons, used in pairs and provided with wire-rope slings, eased the pipe on to the river bed as it was progressively assembled aboard the derrick boat. All six lines were laid in eleven days.

Top, left—A machine of this description can backfill in the course of a day from 6,000 to 7,000 linear feet of trench—doing work that would require a large force of men. Right—Method employed in making a "cold bend" in an 8-inch welded line. Bottom, left—"Bottle sleds" like this one are used to move the gas bottles to points where welders need them. Right—Sections of a 20-inch line assembled with Dresser couplings.

sion—rather than expansion—during the warm months. Much skill and good judgment are shown in disposing of the pipe before refilling the trench. This work is done by mechanical backfillers that can take care of a mile or more of trench in the course of a day.

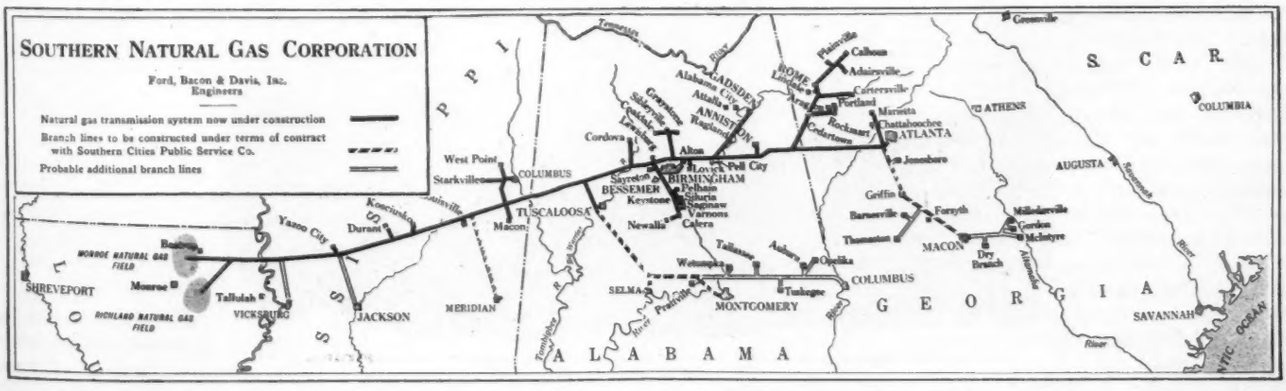
In traversing some swamps and in crossing the eighteen rivers that run athwart different sections of the pipe-line system, the shore ends of the pipe terminate in headers joining them at right angles, and from these headers several smaller pipes are laid underwater. This arrangement insures a continuance of service even if one or more of the multiple pipes should fail for any reason. In most cases, the rivers are crossed with three multiple lines, but six of them were laid under the Mississippi where the river is about 3,000 feet wide and attains a depth of 125 feet. The pipe sections were assembled on a derrick boat, and each joint reinforced with an enveloping clamp weighing nearly 2,000 pounds. These clamps and the weight of the piping made the separate lines heavy enough, even when empty, to sink to the river bottom. As the pipe was assembled on the boat it was skidded into the water when that craft was pulled forward; and the load of the lengthening line was shifted to several pairs of pontoons—held apart—which carried wire-rope slings suspended between them. The slings increased in depth progressively, and this permitted the pipe to be eased gradually from them and on to the water bed.

In another case, the multiple lines were successively pulled from one bank to the other with the head end carried on a float—the lines being previously assembled on the far shore. On occasions, trenches were excavated in the river bottom with water jets; and, after the pipe was in place, mud was dredged back over the line for protection. In crossing some small streams, the practice of one sub-contractor was first to build a cofferdam on the near side for half the width of the waterway and to lay the pipe within the cofferdam. This left half of the stream to flow unobstructedly. Next, a cofferdam was built from the opposite side and half the width of the stream, and the work completed—the first cofferdam being removed to let the water flow.

At various points, the contractors used portable compressors to furnish air to operate rock drills, clay diggers, paving breakers, drill-steel sharpeners, grinders, and oil furnaces; and in a number of instances compressed air was employed to test sections of the line before laying—especially the multiple underwater lines which could not be reached readily later on if any of the joints developed leaks.

The building of the Monroe-Atlanta line, with its branches, has been handled entirely under the direction of Ford, Bacon & Davis, Inc., who employed the five largest contracting concerns familiar with that specialized work. Williams Brothers, Inc., have had a contract for 210.1 miles of main line and feeders and 64.9 miles of branch lines—making a total of 275 miles; the Oklahoma Contracting Company has built 160 miles of main line and 72.9 miles of branch lines—aggregating 232.9 miles; the Hope Engineering Company has constructed 126 miles of main line; the Sheehan Pipe Line Construction Company was awarded the job of building 126 miles of branch line; and Walker & Lawrence have had 75.4 miles of branch line to construct. The entire system is designed to convey gas at a maximum pressure of 400 pounds.

The subject is too big to permit detail here. Therefore, our aim has been to show broadly what the construction of such a pipe line involves, so that those that are benefiting may grasp what has been done for their greater comfort, convenience, and service.



Finished health house ready for occupancy and before the work of the landscape artist had had time to bear fruit.

Air-Sprayed Concrete Used in Building New Type of California Home

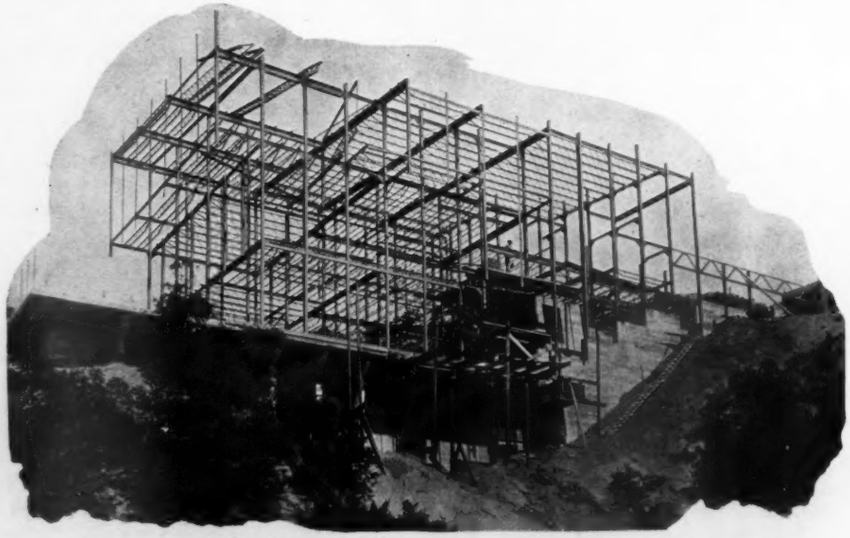
By WILLARD D. MORGAN

CONCRETE walls 1¼ inches thick and shot in place with compressed air may, at first blush, seem inadequate for a structure four stories high. However, such is apparently not the case, as evidenced by the so-called health house recently constructed on entirely new lines in Los Angeles, Calif. Richard J. Neutra, well-known architect and designer of the health house, has in this instance departed from accustomed practices to such an extent that it was necessary for him to secure a special permit from the municipal building department before work on the model home could be started.

The most outstanding feature of this unusual dwelling is its thin walls of concrete —concrete applied pneumatically. Contrasted with walls 13 inches thick, required by the city's building code for ordinary structures of the size under consideration, it can be appreciated why considerable opposition had to be overcome before the needful permit was forthcoming. It was granted only after tests had proved that the walls, as specified by Mr. Neutra, would be of sufficient strength to carry their designed loads and to withstand a wind pressure of approximately 30 pounds per square foot. The thinner walls mean lower cost and a reduction in the dead load of the building—the latter a factor that has its advantages in a section of the country where earthquakes have occurred from time to time. As a matter of fact, the walls are really not bearing walls, as are the masonry walls with which we are familiar. They are curtain walls suspended from a central steel framework. But before going into the details of their construction, a general description of the house, itself, which is decidedly original in conception, should not be out of place.

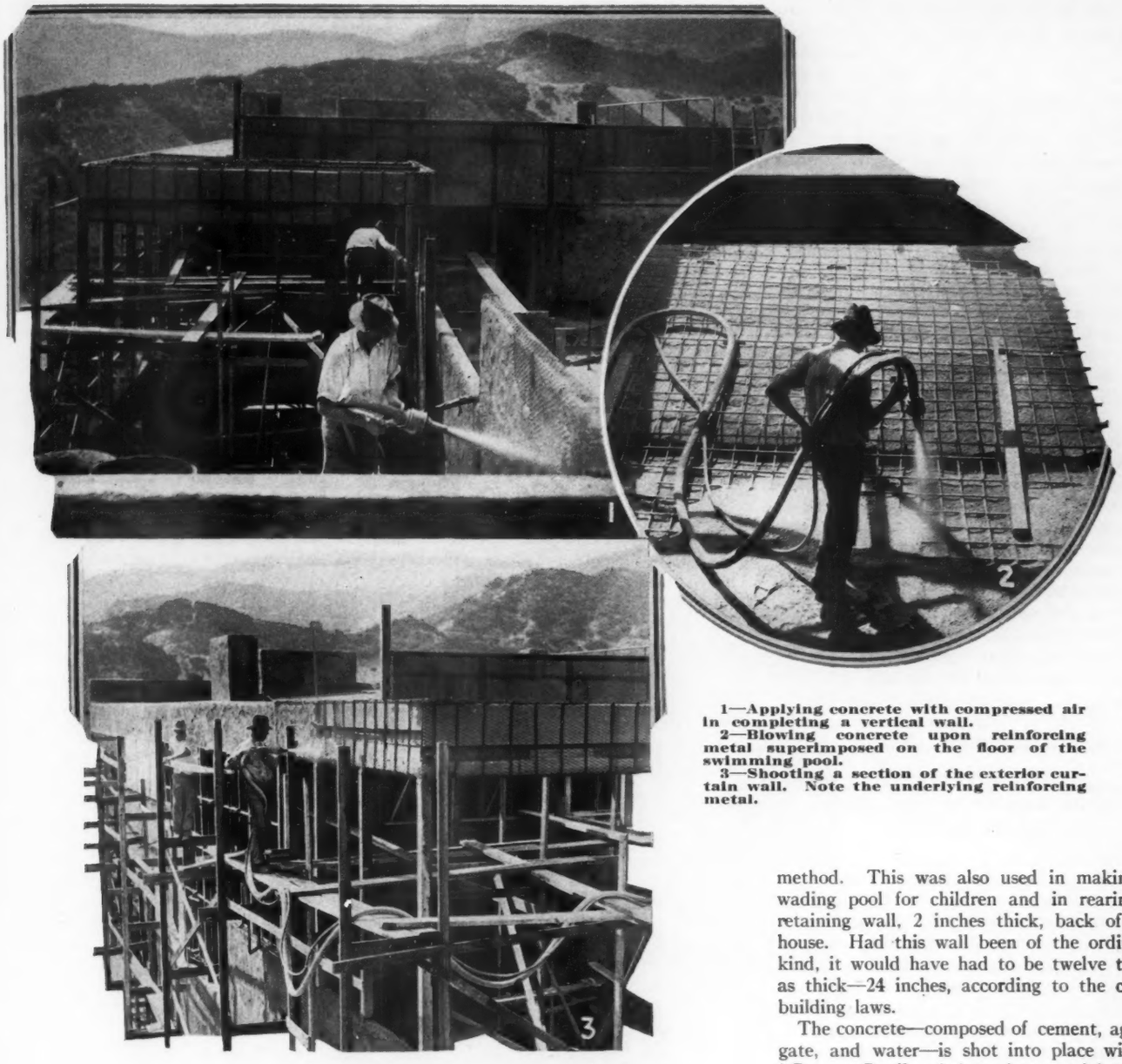
As the name implies, the idea of the architect was to provide an airy, well-lighted abode —in short, a thoroughly healthful place, according to the most approved present-day standards, in which to live and to play. It is characterized, as the accompanying illustrations show, by a minimum of wall space and a maximum of window space; by roomy balconies, sun parlors, and sleeping porches; and by recreational facilities in the form of a swimming pool, tennis court, enclosed playground for children, etc. In other words, the whole plan of this type of dwelling has been to produce something that would meet the demands of the professional worker, especially in the United States, for a home in which he can find both the relaxation and the environment that he is deprived of while he is gainfully occupied and that he is so much in need of after the day's rush of business.

The structural materials, both inside and out, are fireproof, and consist mainly of steel, concrete, plate glass, vitreous and composition paneling, and the like. Not only that, but much of the inside finish is of a kind that can readily be kept clean. For the same reason, all the sanitary fixtures are wall hung. And, as is to be expected of such a modernistic house, it is equipped with every conceivable kind of labor-saving device to lighten the burden of the homemaker. But now let us go back to the main object of this article, to the thin concrete walls which, if they stand up to the service expected of them, will no doubt bring about a change in housebuilding methods.



The steel framework of the health house. This explains how structural strength was assured.

The work of construc-



1—Applying concrete with compressed air in completing a vertical wall.
2—Blowing concrete upon reinforcing metal superimposed on the floor of the swimming pool.
3—Shooting a section of the exterior curtain wall. Note the underlying reinforcing metal.

tion proceeded as follows. After the steel frame had been erected in its entirety, those sections of it that were to constitute the backbone of the walls, both inside and outside, were covered with a heavy metal mesh that was temporarily backed with plaster board against which to shoot the concrete. The steel frame and the mesh were firmly bound together. Stiffening members were placed around all openings—the plaster board being used to fashion forms for window molding, and the like, which were thus made an integral part of the whole reinforced-concrete structure. The wall surfaces were given two applications of concrete—one just covering the metal mesh and the other serving as a finishing coat.

In order to facilitate squaring off the corners of the building, special wire grounds were employed. These wires were pulled taut and secured, in proper alignment, before concreting was taken in hand. The material was then shot past the grounds and, when set, squared by means of a straightedge. Where a wooden ground had to be used, the concrete was blown to the edge of it and left for 24 hours. The next day the wood strip was removed, its position reversed, and concrete applied from the opposite direction. With the wire ground, however, it was possible to finish off a corner at once and to go right on covering the adjacent surfaces.

The large swimming pool is a prominent feature of the health house. As but approximately two-thirds of the pool could rest on solid ground, it was necessary to construct reinforced-concrete U-beams for its support. When the tank was poured within the confines of these beams, numerous tie wires were left protruding inside of it. Then the inner surfaces were coated with asphaltic waterproofing. With that done, the pool was lined with heavy metal mesh which was securely fastened to the sides and the bottom by the wires embedded in the concrete. Thus a second but thinner-walled tank was built up within the first one by the "Cement Gun" method. This was also used in making a wading pool for children and in rearing a retaining wall, 2 inches thick, back of the house. Had this wall been of the ordinary kind, it would have had to be twelve times as thick—24 inches, according to the city's building laws.

The concrete—composed of cement, aggregate, and water—is shot into place with a "Cement Gun" and through a special nozzle designed for the purpose. The aggregate and the cement are put in the hopper of the gun and, in a dry state, fed progressively from there to the nozzle by compressed air—that is, blown from the hopper through connecting hose. After reaching the nozzle, water is added; and, by reason of a churning action set up there, the concrete components are thoroughly mixed before they are ejected forcibly. In this way the concrete is deposited and compacted firmly against the forms and around the reinforcing metal.

To guard against a jerky, pulsating flow of the dry materials, the gun is equipped with a special feed wheel. By thus maintaining a uniform supply it is easy for the nozzleman to regulate the flow of water accordingly, and to make certain of a properly hydrated mix at all times. Air at a rate of 300 cubic feet per minute was furnished by the compressors on the job while the work of concreting was in progress. Some idea of the amount of air consumed can be gathered from

the fact that, in the case of one application, it required approximately 200 cubic feet of air to place a cubic foot of the plastic mass.

As mentioned at the beginning of this article, a special permit had to be obtained from the Los Angeles building department before the contractor could begin work on the health house, as planned by Mr. Neutra. To convince the authorities of the strength of the comparatively thin walls, slabs of concrete of varying thicknesses were put to exhaustive test in the city laboratories. It is interesting to note that specimens from ⅜ to ½ inch thick were able to resist, without strain, the pressures of heads of water of from 700 to 1,600 feet. A 1-inch slab, after being subjected to the pressure of a head of 1,610 feet for a period of 2½ hours, showed no signs of moisture. Not until the water pressure was gradually raised to 3,400 feet did the specimens begin to leak and break in bending.

This new type of home shows what modern machinery has made possible in the way of a radical departure in architectural practice. It exemplifies a pioneer effort in the direction of mass production in a field of construction that concerns the man that wants to live in a house of his own. It also indicates what the creative architect can accomplish through standardization and the employment of facilities that lend themselves admirably to his service. Habitations of this sort would be distinctively American and especially suitable for sections of the country where climatic conditions are favorable to the type.

Where cement and aggregate were mixed and loaded into the air-operated "Cement Gun", at the right, and shot thence to the points of structural application.

SAVING DIGITS AND DOLLARS BY USE OF AIR TRIPS

IN the words of a foreman, "It takes a pretty good guard to keep an operator's fingers out of a punch press." Thus, tersely, he summed up the results of his own observation and the experience of casualty-insurance companies in general.

There are many different types of punch-press guards, all of them designed and installed for the laudable purpose of preventing accidents. And yet punch-press accidents on guarded machines are not uncommon, for operators often display considerable ingenuity in devising ways and means for rendering the guards ineffective.

Some of the early guards consisted merely of barriers which moved to the front of the dies as the presses were tripped by foot treadles. Certain operators—especially those employed on a piece-work basis—thought that the guards slowed up production and, therefore, reduced their earning capacity. As might be expected under such conditions, the guards often became inoperative in one way or another, and accidents continued to happen. Various supposedly curative expedients were tried; but, although punch-press accidents on guarded machines became far less frequent, there continued to be enough of them to cause concern. A thorough analysis indicated that as long as an operator had the free use of his hands while the press was working, he would find a way to get one of them into the danger zone now and then and, eventually, injure it.

It therefore became evident that, in order to insure the greatest reduction in the frequency of accidents, it would be necessary to install protective devices that would meet one or the other of the following conditions: That both hands be needed for the tripping of the press and remain so engaged while the punch travels to the die and returns to its original position, or that the guard be of such a nature as to prevent any movement of the plunger if the attendant's hand or any other obstruction should come in contact with it.

In a certain manufacturing plant the operating of some heavy-duty punch presses was attended by a decidedly unfavorable accident rate. The presses were operated by men, because considerable strength was required to actuate the foot treadles by which they were set in motion. With the idea of precluding the possibility of injury to the hands, instructions had been given to use hand tools in feeding the presses; but, although this procedure was enforced as rigidly as possible, punch-press accidents still occurred frequently.

Engineers of the Travelers Insurance Company, in coöperation with the management, then perfected a system of air-trips which required the simultaneous use of both hands to actuate the levers and to hold them in the operating position during the entire stroke of the press, thus effectually keeping the operator's hands out of the danger zone. In this way the digits were saved.

As already stated, considerable strength was required to operate the foot treadles originally provided on these presses. Dexterity in handling small objects is not usually associated with great strength, but these qualities were necessary for maximum production. With the substitution of the air-trip control, the presses could be operated with but little effort, so that workers of a different class could be employed advantageously. Under the new arrangement there was a saving in wages amounting to $400 a year for each press; and, at the same time, there was an increase in production and a decrease in spoilage. And so the dollars were also saved.

The 2-handed air tripping device with which this press is equipped effectually keeps the operator's fingers out of harm's way and speeds up production.

Reprinted by courtesy of the Travelers Standard.

Of the many new uses to which stainless steel was put in 1929, perhaps the most unusual was the making of identification disks shot into whales in order to trace their movements in the Arctic seas. All sorts of metal plates have been tried for this purpose in the past, but without exception they have induced inflammation that has resulted in the shedding of the disk. Stainless steel is not affected by salt water; and the arrow attached to each marker, once it is embedded in the blubber, remains there until the mammal is caught. Hundreds of these disks were required for the purpose.

Although Europe was the birthplace of the rayon industry, the United States now leads the world in its production.

Driving a Drainage Tunnel For a Coal Mine

This Work Is Going Forward Rapidly in an Isolated Mountain District of Pennsylvania

By S. G. ROBERTS

FOR nearly forty years, water has been pumped hundreds of feet from the depths of the coal mine of the Locust Spring Colliery, now operated by the Philadelphia & Reading Coal & Iron Company. This necessary work has cost a tidy sum in the course of that time; and today the pumps in that mine are lifting anywhere from 7,000 to 10,000 gallons of water a minute during every 24 hours. This is required in order to drain the mine so that operations can be carried forward without being hampered by troublesome seepage.

The Locust Spring Colliery is situated in the heart of a mountainous district to the north and west of Pottsville, Penn. The property is crossed by the boundary line that separates Northumberland County from Schuylkill County, but is entered on the Northumberland County side. This is the logical approach, because on the south side Locust Mountain constitutes a towering barrier to ready access. Even so, underground workings have penetrated southward beneath that great mass, because an exploratory tunnel has been driven for a distance of 2,200 feet under the mountain. That tunnel represents cumulative efforts intermittently made during the past 35 years. The tunnel extends southward from the fourth level of the mine; and the intention has always been to continue it until it reached the open air at a point on the bank of Mahanoy Creek. Apart from revealing the extent of the coal deposit, the purpose was to provide a tunnel that would enable the mine to drain itself by gravity into the creek on the far side of Locust Mountain.

The economies that a drainage tunnel would make possible became so evident a year ago that the Philadelphia & Reading Coal & Iron Company set about putting through to a finish this project that has dragged along unaccomplished for nearly two-score years. To that end, the company entered into a contract with Hugh Dolan & Sons, of Pottsville, a contracting concern that has done much good work in the coal-mining region of Pennsylvania. Hugh Dolan & Sons started operations on September 27, last year; and work has been going forward actively ever since. The tunnel is being driven northward from Mahanoy Creek; and the scene of operations is an isolated place at the foot of the mountain and well off from the traveled roads of that section of the state.

The contractor was not permitted to choose his point of attack—he had to begin work where the 2,200-foot mine tunnel would come out if advanced sufficiently on the line already followed. Therefore, the contractor realized from the beginning that he would have to haul most of his supplies from Pottsville—about eighteen miles away as the crow flies; and it was also apparent that weather conditions at times might make the transporting of equipment and essential materials well-nigh impossible. In such circumstances, it was vital that he should have near his tunnel portal a dependable and self-contained power plant capable of meeting his varied needs. It was also of prime concern that the power plant should make use of a low-priced fuel that could be moved rapidly to the out-of-the-way scene of activities.

After due consideration, the contractor saw fit to place his main reliance in a Diesel engine of the well-known Ingersoll-Rand PO Type—a unit of 110 hp. The fuel for that engine costs but eight cents a gallon delivered from Pottsville; and the machine consumes 3.3 gallons of fuel oil an hour when operating at its working load. The engine, which is of the solid-injection type, is direct connected to an ER compressor, and drives by belt a small Cameron SV pump and a generator of 25 kw. The SV pump takes circulating water, discharged into a sump in the engine house, and delivers it to a cooling tank up on the adjacent hillside, from whence the water is returned to the engine and the compressor. The generator provides current for the electric lights inside and outside of the tunnel; to operate the blower that ventilates the tunnel; and to charge the storage batteries of the locomotive used in hauling the muck cars. The 14x12-inch compressor has a capacity of 528 cubic feet of free air per minute at a pressure of 100 pounds per square inch. The air is used to drive the rock drills in the tunnel; to operate a No. 50 I-R sharpener and a No. 25 I-R oil furnace in the blacksmith shop; to actuate a hoist that handles cars up and down a steep inclined railway; to drive a small general-service Cameron reciprocating pump that raises water from an impounded rivulet to a supply tank on the hill; and to operate the pneumatic mucker employed in the tunnel.

In the foreground is the air-driven Cameron pump that raises water from the nearby pool to the supply tank, 150 feet above on the mountainside. In the middle distance is the inclined railway over which supplies for the tunnel workers are moved.

It should be self-evident that the oil engine has a very important service to perform in carrying on the work; and the way in which it has stood up to the varying load imposed upon it is convincing proof of the wisdom of the contractor in selecting that form of prime mover for the particular job in hand. His choice of that source of power was made in the light of a wide experience and a broad familiarity with the conditions to be met in that part of Pennsylvania. Starting air for the PO unit is supplied by a Type 15 Ingersoll-Rand compressor, driven

Left—Portal of the tunnel by which Locust Spring Colliery will drain into Mahanoy Creek. Right—The tunnel heading is being driven with N-75 drifters—each being mounted on its own 3½-inch, double-screw column. The work is advancing at an average rate of 300 feet per month.

by a 4-hp. Novo engine; and the lubricating oil of the prime mover is made fit for re-use by running it through a Nugent oil filter. This has contributed to operating economy and to the continued and efficient running of the PO engine.

Under the terms of the contract, Hugh Dolan & Sons are called upon to drive a tunnel substantially 3,200 feet long. At its inner end, the tunnel will meet the coal measures and join a previous gangway connecting with a tunnel extending for a distance of approximately 1,900 feet to a shaft—the junction with the shaft taking place on the fourth level of the mine. The tunnel being driven by Hugh Dolan & Sons is of horseshoe cross section. When the scene of operations was visited towards the end of last October, the tunnel had penetrated into the mountainside from Mahanoy Creek about 300 feet, and the work was going forward at the scheduled rate.

The cross section of the tunnel, at that time, was 7x9 feet, making it possible and advantageous for the contractor to utilize an air-driven mechanical mucker. That machine enabled the contractor to operate on two shifts and to do all the mucking called for within that interval. The working force was then made up of 20 men, inside and outside of the tunnel. The contract specified a cross section of 6x8 feet; but the contractor was using a larger cross section so that he could do his mucking by machine. It was apparent that strict adherence to the specifications would not permit the use of the mechanical mucker and would necessitate hand-mucking and recourse to three shifts to get out daily sufficient rock to insure the monthly advance expected—that is, 300 feet every 30 days. The tunnel is required to be finished and ready for service within a year from the start of operations.

The rock encountered from the portal inward for a considerable distance has been a type of red shale. That rock has proved rather troublesome because it has a tendency to flake and is apt to jam the drill steels and to make it very hard to withdraw them occasionally. Notwithstanding the nature of the geological formation, the contractor has been able to maintain a very satisfactory rate of advance; and there is every reason to believe that the job will be completed within the time prescribed. As should be realized by the reader, the tunnel is being driven from a single heading. In doing this, the practice has been to employ a 20-hole round, consisting of side holes 8 feet deep and cut holes 10 feet deep. With this procedure, it has been possible to pull 7½ feet at each round.

Work at the heading has been done with N-75 drifters; and two of these Ingersoll-Rand rock drills are utilized at a time—each being mounted on its own 3½-inch double-screw column, as shown by one of our illustrations. For plug-drilling large pieces of rock, in order to facilitate handling by the mucking machine, S-49 "Jackhamers" have been employed; and these same tools have been used for ditch work in connection with the driving of the tunnel. These drills have been found in every way equal to the work expected of them.

The drill steels are conditioned in a blacksmith shop situated about 100 feet above the tunnel portal and set on the steep mountainside. The steels and other needful equipment are handled up and down the slope on a narrow-gage railway, which can be seen in one of the pictures accompanying this article. Materials are moved on the railway by an air-driven hoist stationed at the top of the climb; and this convenience has helped to offset one of the difficulties of the location.

Looking out from the tunnel portal towards Mahanoy Creek. An Easton muck car is delivering steels to the drill runners.

Left—Blacksmith shop equipped with up-to-date oil furnace and sharpener for conditioning drill steels used in driving the drainage tunnel. Right—This 110-hp. oil engine is the primary source of power for air-driven rock drills and other pneumatic equipment used on the job.

The blacksmith shop is suitably outfitted with a No. 50 sharpener and a No. 25 oil furnace—both using compressed air.

The power plant is housed in a separate building, near the blacksmith shop, and compressed air for work in the tunnel is piped down over the mountainside through a 3-inch line to the portal and carried thence into the tunnel to a convenient point from which flexible connections can be led to the rock drills and to the mucker. Water for the wet rock drills is supplied from a tank 150 feet up the hillside above the portal; and that head is ample for the purpose without recourse to pumping. The water for this service and for other uses about the camp is obtained from a little brook that empties into Mahanoy Creek. This rivulet is dammed so as to form a convenient pool from which the water is raised by a small general-service Cameron pump—air-operated—to the tank mentioned.

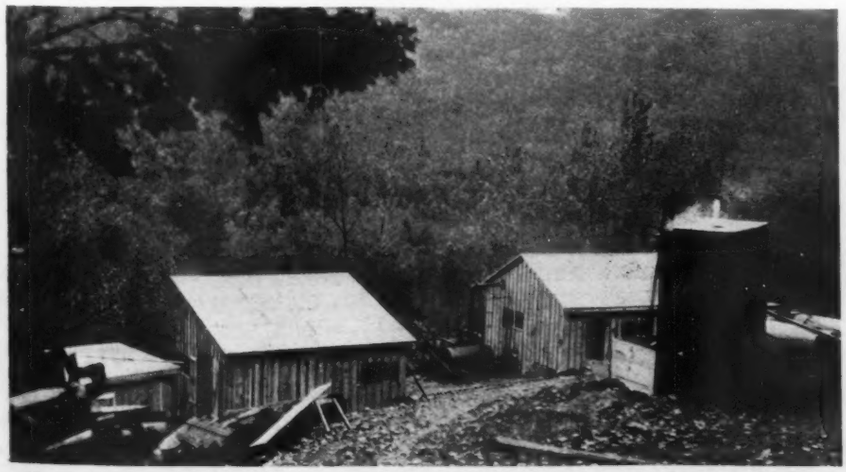
Easton 1-yard cars are employed for mucking; and, in the course of two shifts, between 90 and 100 carloads of rock are moved out of the tunnel.

As previously mentioned, the tunnel is lighted electrically; and the current is furnished by the generator which is belt-driven from one of the flywheels of the PO engine. Current from the same source is utilized to operate the ventilating blower which delivers fresh air to the heading through 24-inch steel pipe. The generator is also called upon, intermittently, for energy to recharge the storage batteries of the locomotive that moves the muck cars in and out of the tunnel. The tunnel has a gradient ranging from ½ to 1 per cent. The ½ per cent gradient extends for a distance of 1,000 feet inward from the portal and from there on rises to the point where the new tunnel will meet the older one.

The tunnel portal enters the mountainside close to the creek and but a few feet above the level of that stream when flowing normally. Like all mountain waterways, Mahanoy Creek is subject to sudden and violent freshets during periods of each year; and it is more than likely that there will be occasional flood levels that will raise the water as high as the portal. Therefore, to safeguard the tunnel outlet against the erosive sweep of the stream, the portal and the adjacent section of the tunnel will be lined with concrete. Whether or not more of the tunnel will be similarly reinforced has not yet been decided.

In order that we may appreciate what the drainage tunnel will do when ready for service, let us understand just what is now done in draining the mine at the Locust Spring Colliery. To move water from the fifth level to the surface it is necessary to lift it—that is, pump it—a total distance of 730 feet. This is at present effected by raising the water from the fifth level to the fourth level, a matter of 130 feet, and then relaying it by other pumps from the fourth level to the surface. Any mine operator will readily grasp what this must cost in view of the volume of water ordinarily disposed of in this way in the course of every 24 hours. The tunnel under construction will take the water pumped from the fifth level to the fourth level and carry it by gravity to Mahanoy Creek—thus obviating the expense of lifting the water 600 feet further surfaceward in order to get rid of it.

Besides obviating the outlay for pumping water from the fourth level to the surface, the new tunnel will render obsolete a water shaft now equipped with a bucket hoist, which handles commonly about 3,500 gallons a minute. Eventually, the tunnel now being driven will be tied with other tunnels and carry off water from two other mines. In



Power house, blacksmith shop, and water tank located on the mountainside 100 and more feet above the tunnel.

short, the tunnel will ultimately drain a basin that will have an approximate length of 6½ miles and a breadth of 1 mile. The operating economies that may grow out of this aqueduct should be large and should pay handsomely for the present expenditure.

Interesting and important as the work in hand is—representing a determined effort to carry to fulfillment a project that has been advocated for a good many years, the outstanding aspect of the undertaking is the part being played by modern mechanical aids in doing the work rapidly and at a reasonable cost. As we have seen, air-driven rock drills and other pneumatic equipment are figuring conspicuously in what is being accomplished with a comparatively modest organization—just one more example of the labor-lightening facilities that a contractor can now muster to his service. Significant as this is of the present-day trend, none of these apparatus could have been used in the absence of the primary power developed by the economical and efficient PO Diesel oil engine of the solid-injection type. That unit has met successfully all the conditions imposed by an isolated site in a mountainous region that placed added emphasis upon operating dependability.

Receivers arranged in tandem outside the power house. The large pipe at the left carries compressed air down to the tunnel, about 100 feet below.

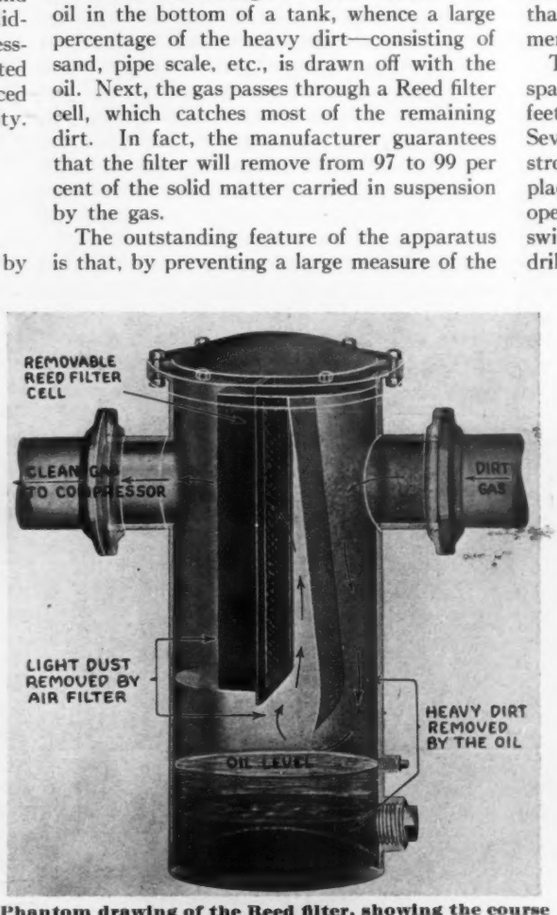
SHOCK ABSORBER FOR THE DEEP-WELL PUMP

A SHOCK absorber has been developed by the Union Machine Company that is said to do for the deep-well oil pump what similar equipment has been doing for years for the surface pump. It is well known that surface pumps operating against pressures ranging between 500 and 1,000 pounds have some kind of absorber to take the shock caused by the action of the pump piston against the solid fluid column. Yet, strange as it may seem, pumps designed for deep-well work have, apparently, been called upon to operate at depths of from 1,500 to 4,000 feet and against corresponding heads without any such provision against shock. This has led, among other things, to split tubing, the breaking of sucker rods, and the wearing of cups, barrels, and valves. It is claimed for the new "aleviator", which is in the form of an air chamber, that it lessens the shock load 33 per cent and increases and steadies the flow 25 per cent by actual weighing-machine test.

FILTER FOR GASES

A NEW gas filter, suitable for cleaning natural gas or air before it enters gas compressors or vacuum pumps, has been placed on the market by the Reed Air Filter Company. The gas going into the filter, as the accompanying drawing shows, is deflected downward and brought in close contact with oil in the bottom of a tank, whence a large percentage of the heavy dirt—consisting of sand, pipe scale, etc., is drawn off with the oil. Next, the gas passes through a Reed filter cell, which catches most of the remaining dirt. In fact, the manufacturer guarantees that the filter will remove from 97 to 99 per cent of the solid matter carried in suspension by the gas.

The outstanding feature of the apparatus is that, by preventing a large measure of the foreign substances from reaching the filter cell, that unit can remain in service over proportionately longer periods. In short, it does not have to be taken out as often for cleaning as would otherwise be the case. The filter is of sturdy construction; and it can withstand a complete vacuum or several hundred pounds of pressure. At the present time it is being built in two sizes with maximum capacity ratings of 800 and of 1,200 cubic feet per minute, respectively. The manufacturer also recommends the use of this apparatus for the protection of vacuum pumps against wear and valve trouble caused by dust.


REMOVABLE REED FILTER CELL
CLEAN GAS TO COMPRESSOR
DIRT GAS
LIGHT DUST REMOVED BY AIR FILTER
HEAVY DIRT REMOVED BY THE OIL
OIL LEVEL

Phantom drawing of the Reed filter, showing the course followed by gases in process of cleaning.

PUTTING HOLES IN RAILS WITH SPECIALLY MOUNTED DRILL

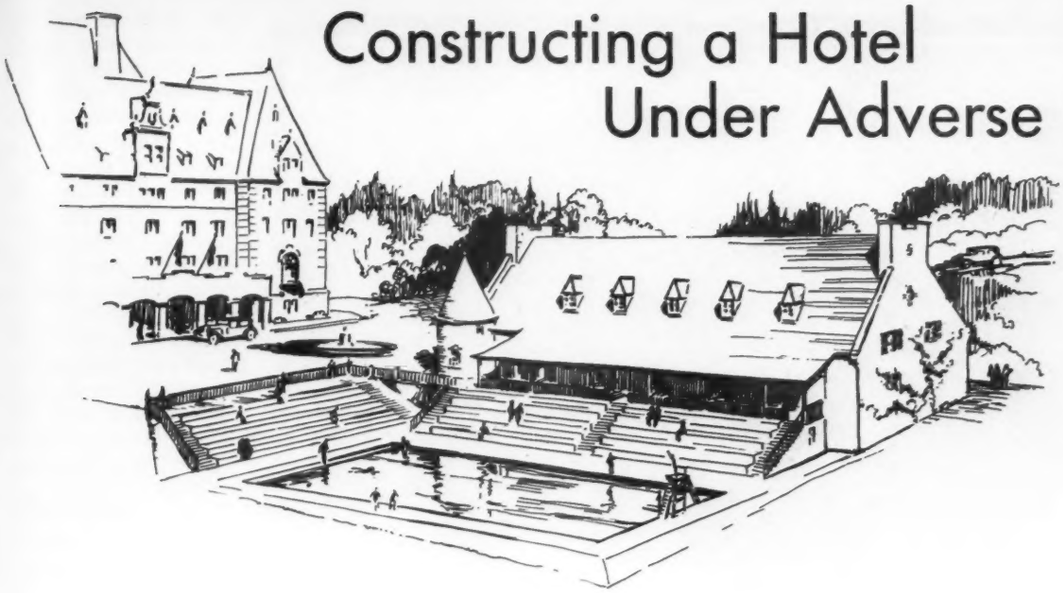
A RAILWAY shop not long ago had a job on hand that was a little out of the ordinary. It was easy enough, in itself, but none of the available machinery could take care of it. So a special contrivance was rigged up that worked so well in that particular case that it has become part of the plant equipment.

The job involved putting rivet holes, closely spaced, the length of a lot of steel rails 12 feet long. And this is how it was done. Several rails at a time were laid across two strong metal horses of such a height as to place the rails within easy reach of the operator of an air drill that is secured to a swinging boom in such a way as to give the drill a 12-foot working radius.

The boom consists of an 8-inch I-beam along which travels, on wheels, a frame made of ½-inch metal. Attached to the bottom of this frame is a yoke, from either end of which is suspended a strong spring coil terminating in a loop through which the handles of the drill are passed. Two slotted extensions reaching down from the frame also serve to hold the drill in position. This outfit requires the services of two men, and is instrumental in turning otherwise toilsome jobs into relatively light ones, and all because of the adaptability of the air-operated drill.

Not to be outdone by the City of New York, which is planning a skyscraper with a mooring mast for Zeppelins atop of it, Los Angeles, Calif., is ready to erect an industrial building that is of such proportions that its roof is to serve as a port for airplanes. The structure will be 980 feet long and 152 feet wide; but platforms projecting from the roof will increase the available landing area to 200x1,200 feet.

Constructing a Hotel Under Adverse Conditions



Pen-and-ink sketch of the swimming pool which is supplied with salt water from the St. Lawrence River and heated when comfort so requires.

Manoir Richelieu at Murray Bay, Canada, a Happy Admixture of the Historic Past and the Present in Architecture

By JEAN DUBOIS

A GREAT many Canadians and a large number of Americans recall with pleasure the wooden-built Manoir Richelieu that for years occupied a commanding position on a plateau overlooking beautiful Murray Bay and the broad sweep of the majestic St. Lawrence. That well-known hostelry drew to it annually patrons that were keenly appreciative of the distinctive charms of the resort. All went well until fire destroyed that hospitable structure in September of 1928.

The success of the old Manoir Richelieu was such that the proprietors realized immediately that hundreds of their erstwhile guests would be at a loss for their accustomed enjoyment if they could not return to Murray Bay in 1929 and be sure of accommodation. Therefore, almost before the last of the smoldering embers ceased to burn, steps were taken looking to the prompt construction of a still more commodious hotel that should replace the original and familiar Manoir Richelieu.

It can be stated that so skillfully were the labors of the architect and the contractor coördinated that the rearing of the new building was carried forward with remarkable rapidity. This was accomplished in spite of decidedly trying circumstances, because much of the work had to be done during winter months when the temperature not infrequently registered a goodly number of degrees below zero Fahrenheit. But before we tell how operations were made possible at that season and in that section of Canada, it would not be out of place to mention why Murray Bay and the Manoir Richelieu have proved so alluring in the past.

If one will take the trouble to examine a map of eastern Canada, the physical advantages of Murray Bay as a place of relaxation and recuperation will become at once manifest. The site of the old Manoir Richelieu was set on the foothills of the Laurentian Mountains—the oldest mountain range in the world, with fragrant forests of balsam and pine nearby and extending far above and beyond into the primordial hinterland. Murray Bay is situated where the flood tides and the incoming winds from the Gulf of St. Lawrence carry with them the tang of the sea, and where the outward-bound waters are drawn from the very heart of the continent. No wonder, then, that Murray Bay should have become a summer colony of distinction and that the original Manoir Richelieu should have won for itself a clientele appreciative of the bounties of nature and good management.

An artistic architectural sketch from which the plans of the Manoir Richelieu were developed. Surely, it would be hard to find a more picturesque site for a hotel.

Tadousac, which lies at the mouth of the Saguenay River—a little to the eastward of Murray Bay, was, in the centuries gone, the recognized center of the fur-trading region dominated by the Company of New France. That Company was formed by Cardinal Richelieu to colonize and to govern Canada; and a monopoly of the fur trade was one of the prerequisites of that organization. The outstanding part played by Cardinal Richelieu in the development of Canada under France is familiar to all of us; and it was befitting that the name of that powerful historical figure should have been chosen for a hotel set up in that particular region. In a measureable degree, the guests in the old hotel were surrounded with reminders of the picturesque pioneer days when the people of New France represented a commingling of the graces and customs of European courts with the robust and boisterous habits of the frontiers. A studious effort has been made to revive something of this atmosphere in the new Manoir

Richelieu and to make it something in the way of a museum displaying evidences of the stages by which the Dominion of Canada has advanced to its present splendid status.

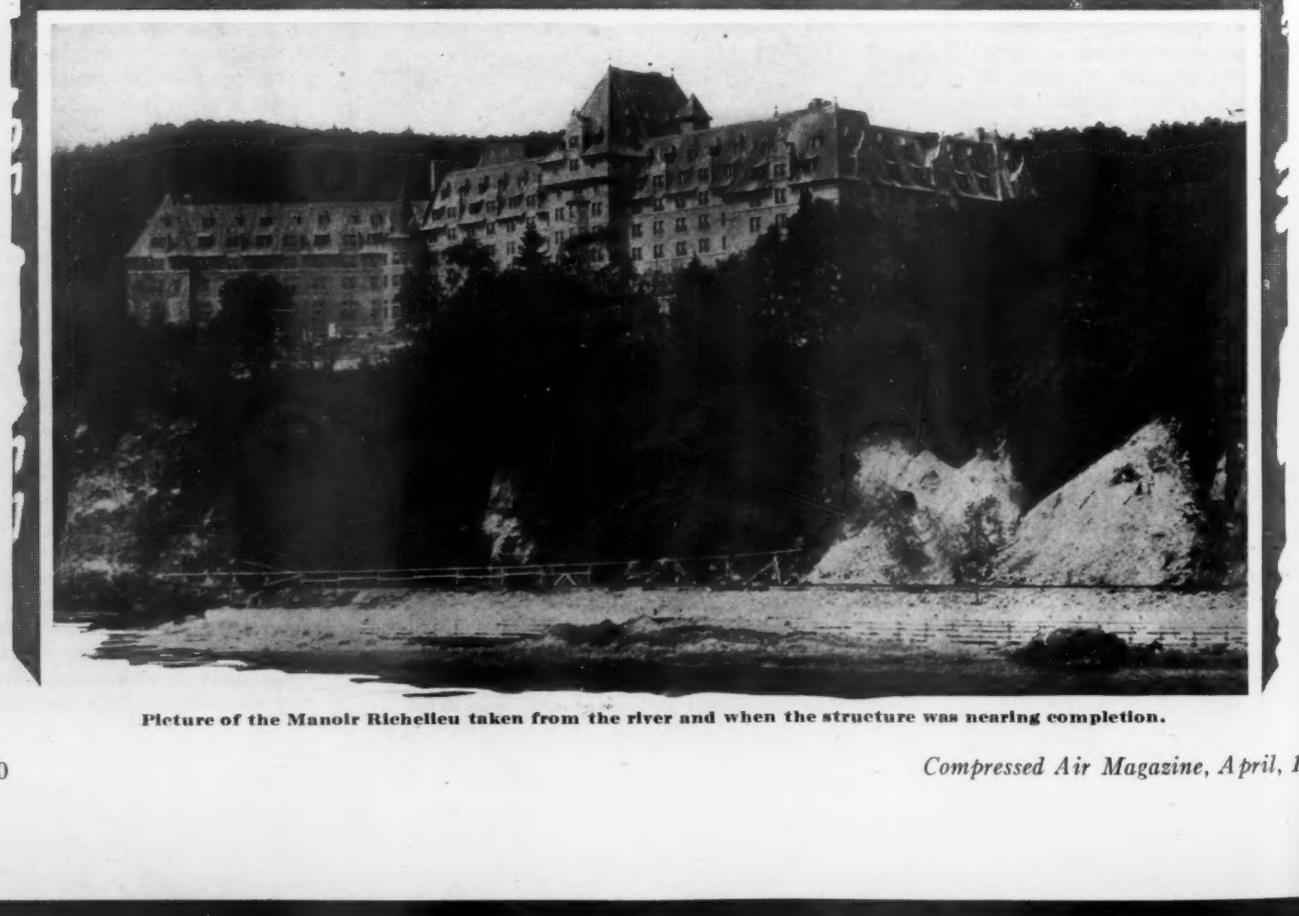
The new and far more pretentious Manoir Richelieu, which is capable of taking care of 600 guests, has been designed to carry on the traditions of the famous hostelry but in keeping with thoroughly modern standards of summertime accommodation. The design, as developed by John S. Archibald, of Montreal, represents an adaptation of the characteristic features of an ancient French monastery; and Manoir Richelieu, besides being architecturally impressive, fits with similar appropriateness into the natural charms of its surroundings. For the most part, the structure is notably different from other hotels on this continent. Its appeal to the traveler is made greater because modern science and invention have contributed generously to the details as well as to the broad features of the building. In much of this work J. B. Carswell, consulting engineer of Hamilton, has had an important share.

Retouched photograph illustrating the manner in which the grounds are to be planted by the landscape gardener.

How well the Manoir Richelieu combines the past and the present has been thus described by *The Gazette* of Montreal: "The interior decoration scheme is quite unique in hotel decoration. Never before has a resort hotel so successfully captured the atmosphere of two centuries ago and molded it into all the luxuries of modern living. In the public rooms there is the magnificence of Royal France, and in the bedrooms the beauty of habitant handicraft has been preserved in all its color and vigor in the draperies and the furniture."

As has already been mentioned, a prime desideratum was the prompt replacement of the destroyed hotel, and to this end the general contractor, Wilde & Brydon, Ltd., of Montreal and Toronto, began excavating on the very day that the first sketch of the new Manoir Richelieu was started. From then on the architect and the contractor were obliged to work hand in hand and under exceptionally difficult conditions. Concrete was used extensively in constructing the new hotel; and most of us are aware that wintertime ordinarily hampers work with this material. In the case of the Manoir Richelieu, the desired outside finish could be assured only by stripping the forms within from eight to twelve hours after pouring—this variable being governed by the thickness of the walls. At that time, the prevailing temperatures in the neighborhood ranged from zero to 36° below zero!

The contractor would have been balked in this part of his undertaking had he not resorted to the expedient of rearing an outer wooden shell that enveloped the whole structure. Within this temporary enclosure it was possible for him to maintain the temperature required for curing the concrete by installing an extensive system of steam coils. Thus the rigors of winter were offset and an atmosphere produced that permitted the continuous pouring of concrete without fear of damage by frost. When the concreting was completed, the plasterers and other workers were able to do what was expected of them under temperature conditions approximating those of summertime even though the thermometer out-



Picture of the Manoir Richelieu taken from the river and when the structure was nearing completion.

side registered around zero.

Our pictures of the hotel show plainly that the concrete work on the hotel was of a high architectural order; and the dormers, finials, and molded ornamentations had all to be poured in place and under decidedly adverse conditions. Fortunately, much of the exterior concreting was blown into place with "Cement Guns"—the air needed for this purpose being furnished by two Type 20 portable compressors. Climatic or seasonal circumstances were not the only handicaps that had to be contended with during the period of building operations. The general contractor had to draw most of his labor and materials from afar. Murray Bay is an out-of-the-way section of the Province of Quebec in the wintertime. The village of Pointe au Pic is the nearest community, and was able to furnish but a limited supply of common labor. The majority of the workers and substantially all the tradesmen had to be moved to the job from outside points and housed and boarded by the contractor. At the height of activities there were as many as 1,250 men on the property; and rather skillful organizing was required to take care of them and to insure contentment.

All photos courtesy Canada Steamship Lines

Two Canadian Ingersoll-Rand portable compressors that furnished air to operate the "Cement Guns" used in placing the stucco on the facade of the Manoir Richelieu.

The Manoir Richelieu is set on a tableland or cliff nearly 140 feet above the railroad track that runs along the shore; and materials and other supplies received by rail had to be hauled up an inclined railway built for that purpose by the contractor. This convenience obviated a 2-mile haul by a road having steep grades made all the more difficult by the snow and ice of winter. Stone was obtained from a quarry opened nearby by the contractor; and it was crushed and screened to suit his purpose. Sand was drawn from a local beach.

Thanks to the energy and the well-directed efforts of every one concerned, the Manoir Richelieu was made ready for service within a period of only eight months from the time work started. The outcome is highly creditable to all that have contributed to the success of the undertaking; and Murray Bay today can boast a hotel that can offer much to people seeking something distinctive and different in the way of a retreat.

AIR DRILL SUPPLIES POWER TO DRIVE TAPPING MACHINE

By C. P. McGrath

SOMETIME ago we described in these pages a pneumatic pipe-cutting machine conceived and used in the field by the water-supply department of a midwestern city. The driving power for the cutter was furnished by an air drill. This same handy tool is now being employed by that enterprising municipal department in a kindred fashion but in connection with a tapping machine. Through suitable gearing interposed between the drill and the tapping machine the speed of the drill is stepped down in such a way as to supply sufficient power to operate the thread-cutting machine.

The close-quarter drill, as the accompanying picture shows, is attached to the gear reduction by metal straps. The gears are mounted on suitable shafting with bronze bearings—the shafting being held by two ½-inch steel plates on which are mounted the bearings for the shaft ends. The drill has a taper socket, and in this is placed a taper shank with a square-socket coupling that fits over the squared end of the pinion shaft of the gear reduction. In turn, the low-speed shaft of the gear reduction is fastened to the tapping machine by means of a squared socket. Thus the rate of speed is reduced from 140 to 4 revolutions per minute. The air for the drill is produced by a portable compressor.

To make adjustment easier in the ditch, the side plates of the gear reduction are equipped with rollers; and, when in use, the machinery is braced against the side walls to prevent movement. This outfit is used by the water-supply department in question to thread 8-, 10-, 12-, and 16-inch sleeve and valve taps.

Assembly of the air-operated tapping machine at work cutting threads in a water-main connection.

REMOVING SNOW WITH A JET OF COMPRESSED AIR

"COMPRESSED air certainly is great stuff! Why, it would have taken me no end of time to clear those beams if you hadn't come along with your air line. Great stuff, I say!" These admiring words were uttered by a carpenter leaning on a broom with which he had attempted to sweep away the fairly deep but light snow with which the timbers, that were needed for the day's work, were covered.

The man addressed had appeared on the scene equipped with a pneumatic auger that was linked to a compressor in a nearby shop and was all ready to start boring holes in the beams. When he saw his fellow-worker laboring over his job of snow removal, and making little headway at that, he quickly disconnected the pneumatic tool from the long flexible hose, opened the air valve, and proceeded with the jet of compressed air thus released to blow the timbers free of the encumbering snow. This all happened within a few minutes, and only goes to prove that the man that works with compressed air is not slow to appreciate its adaptability and to make it serve him whenever he can practically do so.

Sweden is planning to improve her highways on a big scale, and has submitted to the Minister of Communications a program involving an expenditure, over a period of eight or ten years, of $15,000,000. Something like 1,650 miles of roads are in large part to be rebuilt.

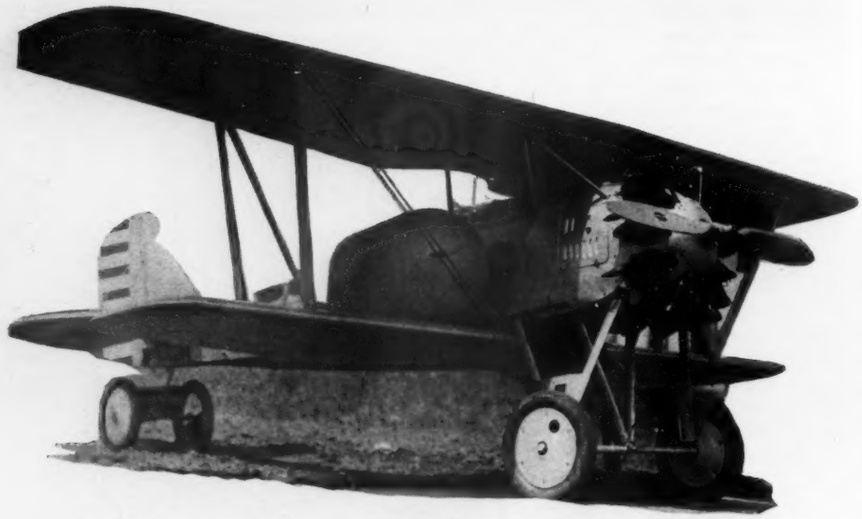
FLOTATION BAGS FOR NAVY LAND PLANES

THE adoption by the United States Navy of "flotation gear" for its land planes, now enables the pilot of a plane so equipped to make a forced landing in deep water without undue risk of a fatal accident. This marks another great step towards safety in flying.

The mechanism of this apparatus, now furnished as standard equipment on the new navy bombers, is simple to install and so easy to operate as to be practically foolproof. The pilot, in time of emergency, merely pulls a control lever—the whole function of inflating the flotation bags being thus performed rapidly and entirely automatically. A small compartment with a panel door that opens outward and downward is built into each side of the fuselage. In each compartment is folded a bag of heavy gasproof fabric, one side of the bag being permanently fastened to the framework of the fuselage. The two bags are connected by steel tubing with a steel flask which may be charged with compressed air or with a non-inflammable gas. A small lever just alongside the pilot's seat controls the outlet valve of this container.

When a pilot realizes that he must alight on the water, all he needs to do is to pull the valve-control lever. He is then free to concentrate on bringing his disabled craft down safely. The instant the mechanism is set in motion, the air under pressure begins to flow from the flask through the tubing to the compartments with their folded flotation bags, where it enters in each case, a small cylinder. A piston in the cylinder is forced downward, thereby throwing open the panel door and releasing the bag. The opening of the door automatically operates a valve, causing the air or gas to rush through the cylinder into the bag and to unfold and to inflate it. Less than thirteen seconds elapse from the time the lever is pulled until both bags are completely distended and ready to float the plane.

When the plane alights on the water, it immediately settles down until all but the top of the fuselage and the upper wing are submerged; and the inflated flotation gear will keep it afloat in that position indefinitely. The depth at which the plane floats causes it to rise and fall with the waves, in other words, enables it to ride out fairly heavy swells while awaiting assistance.



Flotation gear, inflated, on a United States Navy bomber shown on land at the Naval Air Station, Anacostia, D. C.

Photos, United States Navy

Close-up of the flotation gear inflated and with the aircraft resting upon the water.

An apparatus which accurately determines the absorption and moisture content of concrete aggregates as well as the quality of freshly prepared concretes has been conceived after several years of effort by an instructor of the Iowa State College. The machine is said to be able to do in ten minutes work that otherwise cannot be done in less than three hours.

LENGTHENING THE USEFUL LIFE OF RUBBER COMPOUNDS

DURING the past few years, the rubber industry has been developing materials which, when added to rubber compounds, will retard the deterioration of the latter. Several such materials are now employed, and have been found to be decidedly effective in the case of rubber products that are more or less sheltered at all times from the sun's rays. Rubber goods exposed to sunlight, however, represent a more troublesome problem; but in this direction, too, progress has been made. Treatments have been discovered that, according to the Government, at least considerably retard the cracking and checking caused by the sun's action.

Samples of treated and untreated rubber tubing, conditions otherwise being equal, were subjected to tests during the past summer—some of the treated specimens containing so-called antichecking substances and others a wax commonly used for this purpose. With the tubing under a slight tension, checking was noticeable on the "controls" within fifteen days, while the samples protected against deterioration did not show any signs of it for 90 days.

It has been determined that wax, in amounts necessary to prevent sun-checking, has a tendency to "bloom" to the surface—a feature which prohibits its use in some rubber articles. While the "blooming" characteristics of the commercial antichecking materials have not been thoroughly investigated, the experiments so far made by the United States Bureau of Standards indicate that rubber compounds treated with these preservatives can be employed in cases where rubber containing wax would be objectionable because of the surface bloom.

CREDIT

ON page 2988 of our January issue was a short article entitled *Pneumatic Tapping Hammer for Blast Furnaces.* Through an oversight we failed to give credit to *Demag News* for the facts and the illustrations.

Observation station maintained by the National Park Service at Yavapai Point in Grand Canyon National Park.

Photo by Fred Harvey

Activated-Sludge System Installed in Grand Canyon National Park

This Plant Makes Possible the Re-Use of Sewage Water for Non-Domestic Purposes

By M. R. TILLOTSON*

WHETHER or not it is true that the word "Arizona" is a contraction of the words "arid zone," those at all familiar with the Southwest realize fully the importance of water as an agent in the economic growth of that semi-arid country.

The number of tourists visiting that greatest of natural wonders, the Grand Canyon of Arizona, is annually increasing rapidly; and for the travel year closing September 30, 1929, it was necessary to supply water for 162,715 visitors in addition to the permanent population of some 400 people. Furthermore, water must be provided for operating a steam power plant with a rated capacity of 1,282 boiler horsepower, for the many locomotives on the local branch of the Santa Fe Railway, for two large hotels, a laundry, and an ice plant, for some 150 head of saddle horses and mules used on the various trail trips, and for irrigating lawns and gardens around the hotels and residence buildings. Every drop of water for these various requirements is hauled by rail in 10,000-gallon tank cars a distance of 122 miles and at an actual delivery cost of $3.09 per 1,000 gallons. Water in that vicinity is therefore expensive and a commodity that must be conserved to the limit. For that reason it became apparent that it would be desirable to provide a sewerage system of a type that would purify sewage to such a degree that the treated effluent might be re-used for boiler make-up, flushing outside toilets, irrigating, and for other similar non-domestic purposes.

*Superintendent, Grand Canyon National Park, Arizona.

With but one source of water supply, namely tank cars, the problem of determining the water consumption and, consequently, the sewage flow was simple. As a preliminary step to designing the system, there were compiled records, both tabular and graphic, of the actual water consumption over a period of years. These were obtained from freight records of the Santa Fe. As a check on computations and estimates of probable future demands, the graphs representing actual consumption and probable sewage flow were curved and extended to include the year 1940.

A stretch of the Kaibab Trail in Grand Canyon National Park under winter conditions.

After a careful and detailed study of the situation, the treating plant finally decided upon was of the activated-sludge type. The outstanding factors leading to this decision were: the degree of purification required to make the effluent fit for re-use; the lack of natural filtration beds and the excessive cost of artificial, sand filter beds which would be needed in connection with the Imhoff or other similar system; the fact that there would be no need of dewatering the sludge; the degree to which the character of the effluent might be controlled; and the fact that the Santa Fe Railway Company offered coöperation in the way of furnishing power and operating labor.

Briefly stated, the principle of the activated-sludge process is based on the agitation of a mixture of raw sewage with from 15 to 25 per cent of its volume of biologically active liquid sludge in the presence of ample atmospheric oxygen for a sufficient period of time to coagulate a large proportion of the colloidal matter. This air agitation is followed by a period of sedimentation, during which time the flock formed during the process of aeration settles as a thin mud or sludge while the clear supernatant liquid is drawn off as effluent. The biological changes in the process occur in the aeration tank. These changes are dependent on the aerobic organisms which are there intensively cultivated and for the growth of which the necessary free oxygen is

supplied by air forced through the liquid during the process of aeration. The sludge which settles in the sedimentation tank is heavily inoculated with aerobic bacteria. As this is drawn off and mixed with the raw sewage, the latter, of course, becomes so inoculated, thereby hastening the action throughout the entire process.

Because of the large amount of soap, soda, and chemicals used in washing, it was at first thought that laundry waste could not be treated by the process so as to produce an effluent suitable for boiler make-up water. However, after a long series of experiments, laundry waste was finally turned into the plant along with the raw sewage—the only appreciable effect on the effluent being a decrease in the non-carbonate hardness and increase in the alkalinity from around 30 to around 80 p.p.m. No complaint on the score of any ill effect on the boilers has ever been made.

Raw sewage is handled by a 10-inch vitrified-clay pipe line, while a 6-inch line carries the laundry waste. Manholes along the trunk line are of the double-compartment type with raw sewage flowing through one compartment and laundry waste through the other. There are twenty such manholes along the trunk line, and in no instance are they spaced more than 470 feet apart. The line is laid on a uniform gradient of 0.50 per cent.

Just before entering the treatment plant proper, the sewage passes through a double-compartment, coarse-bar screen to remove rags, sticks, and other large matter that might accidentally come through the line. From there it flows into a pre-settling tank with a double-hopper bottom which is 4 feet deep and starts at a point 5 feet down from the top of the tank. This serves a double purpose: first, that of a settling basin for the heavier solids, which are allowed to collect in the hopper bottom and are drawn off at regular periods and sent down the effluent line without treating; second, that of a storage basin in which to hold the flow for a few hours in case of a temporary shutdown. From the pre-settling tank the raw sewage flows to a concrete diversion box where it is mixed with the inoculated sludge and from which, by means of shear gates, the sewage may, in an emergency, be by-passed around the entire plant or sent in the regular course of treatment through the aeration tanks, each having an effective depth of 11 feet. The aeration tanks are of the ridge-and-furrow type, and each contains two rows of air-diffuser plates with 37 plates to the row.

In designing the tanks for this system a decided innovation was made which led to simplified construction methods and lowered their cost. Heretofore the diffuser plates have been set in precast concrete containers, and it has also been the practice to run a separate air line for each plate or small group of plates, making for a complicated and expensive system of piping. The present arrangement consists of an air channel or header, 11 inches wide by 7 inches deep, which is built in the floor and runs the full length of the tank directly beneath the plates, which are 12 inches square by 1½ inches thick. The upper 1½ inches of this header is 13 inches wide, thus forming a shoulder on which the plates rest and leaving a ½-inch space along each edge that was filled with cement grout after the plates were in place. Transversely across this header are fitted 2½x1¼-inch T-irons, the flanges of which afford a support for the remaining two edges of the plates. Thus but one 3-inch pipe is required to supply the air headers from the channel forming the header—the air being equally distributed through all the plates in the row. It is believed that this is the first air-distribution system of its kind to be used for the purpose. Of course, the plant is small compared with some in use in big cities; but there is no reason why the same principle and the same method of air application could not be adapted to meet the needs of a treating plant built on a much larger scale.

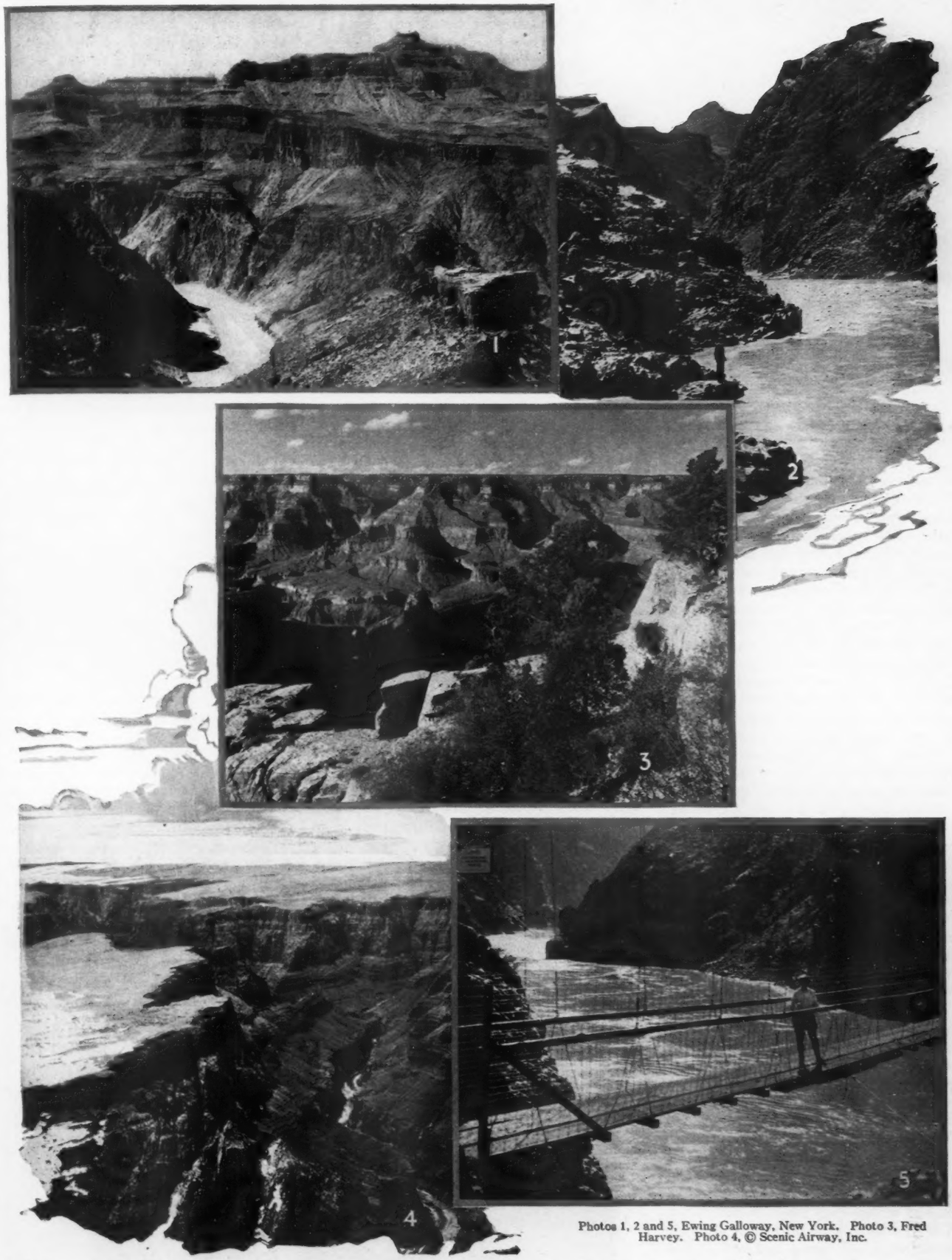
The two aeration tanks are arranged so that they may be used either independently or in series. In the latter case the flow passes from one into the other through a port in the dividing wall and thence into the channel leading to the slow-settling tank. When operated in series the flow through them may be sent in either direction.

Compressed air is furnished by a single-stage, rotary turbo-blower having a capacity of 200 cubic feet of free air per minute against a 10-pound pressure. In practice the air is delivered under a pressure of only 5 to 6 pounds per square inch—just sufficient to overcome the hydrostatic head of the liquid

Left—Near view of the aeration tanks showing raw sewage being agitated and aerated by compressed air.

Right—Comprehensive view of the activated-sludge sewage-treatment plant, with pre-settling tank in the foreground.

Bottom—Corner of the machinery room with electric control switches on the wall and motor-driven low-pressure air compressors on the floor.



Photos 1, 2 and 5, Ewing Galloway, New York. Photo 3, Fred Harvey. Photo 4, © Scenic Airway, Inc.

1—Inner gorge of the Grand Canyon as seen from the Suspension Bridge Trail when looking down the Colorado River. 2—Colorado River as it appears at low water from the end of Bright Angel Trail. 3—Grand Canyon seen from El Tovar Hotel. The camera fails to record the amazing coloring of the age-wrought formations. 4—Inner gorge of the Grand Canyon viewed from an airplane. 5—Swinging Bridge across the Colorado River with swirling rapids below.

The two sterilizers that apply the liquid chlorine to the treated effluent.

in the tank and the friction in the pipes and air-diffuser plates. Because of the principle on which this blower operates the air is water-washed so that supplementary air filters are not required. The plant is equipped with two such blowers, used alternately a week at a time. This provides a standby unit.

After the sewage has been air agitated it passes from the aeration tanks down a trough and thence through submerged ports into the sedimentation or slow-settling tank, 13 feet deep. Here the mixture is allowed to remain quiescent so that the sludge will settle out and the supernatant liquid flow off over a 12-foot submerged weir. Supported by the walls of this tank is a Dorr clarifier which revolves at the rate of one revolution every eight minutes so as to avoid setting up currents in the liquid. Raker arms continually work the sludge to the center of the tank, the bottom of which slopes slightly from the periphery. Through a cast-iron line the sludge is then withdrawn and, by means of an air lift, returned to the diversion box where it is mixed with the raw sewage, as previously described. As more sludge accumulates than is required to maintain a 20 per cent sludge content in the aeration tanks, the surplus may be drawn off by gravity and wasted down the effluent line.

After flowing over the 12-foot submerged weir the liquid flows down a trough, through a Stein weir, and thence into two filters of the sand gravity type. The filtration medium consists of 20 inches of gravel, arranged as follows: 8 inches of a size passing a 2½-inch mesh screen and retained on a 1½-inch screen; 4 inches passing 1½-inch and retained on ¾-inch mesh; 4 inches passing ¾-inch and retained on ¼-inch mesh; and 4 inches passing ¼-inch and retained on 1/12-inch mesh. On top of the gravel is a 32-inch layer of sand.

Specially designed, large cast-iron underdrains collect the filtered water and carry it through Venturi meters to the clear well from which the finished product is pumped back to town through a 6-inch cast-iron main by 2-stage, 20-hp., automatically controlled turbine pumps. The treated effluent is sterilized by liquid chlorine applied at the suction end of the pumps by two Wallace & Tiernan vacuum-fed chlorinators automatically regulated by solenoid valves. Automatic gages indicate the loss of head in each filter, and thus inform the operator when a filter begins to clog and when it should be washed. Water for this purpose is stored under a 30-foot head in a 12,000-gallon corrugated-metal tank located on a hill above the plant. In washing, the filtration process is simply reversed. By means of gate valves, the flow from the wash-water tank rushes down through an 8-inch cast-iron line, is forced into the underdrain, and rises through the sand and gravel of the filter, floating off and carrying the accumulated mat away to a 15,000-gallon concrete settling basin.

From 6,000 to 8,000 gallons are used at a washing, and none of this wash water is wasted. It is pumped from the settling basin back into the pre-settling tank, whence it passes through the plant. The only waste in the entire system consists of the solids drawn from the hopper bottom of the pre-settling tank—approximately 630 gallons every 24 hours—and of the excess sludge. The design does not include fine screens nor provisions for reaerating sludge.

Except for certain siphons and trestles, the effluent line below the plant is of 8-inch vitrified clay pipe. It is 3.39 miles long and empties into the head of a draw which eventually drains into a semi-arid country entirely removed from any settlement. Along the effluent line there are two inverted siphons and four trestles in which were used 2,138 feet of 8-inch centrifugally cast iron pipe. The bell-and-spigot joints of the pipe were lead calked with a pneumatic calking hammer drawing air from a 4¼x4-inch Ingersoll-Rand portable compressor. The joints were tested with ether and air under a 100-pound pressure. There are 55 single-compartment manholes along the effluent line. Throughout the line the joints of vitrified pipe were sealed with oakum and petrolastic cement.

The 4.44 miles of trunk and effluent line involved 6,583.5 cubic yards of excavating—consisting of 34.3 per cent solid rock, 23.8 per cent loose rock, 25.5 per cent clay, and 16.4 per cent earth—and 1,301.1 cubic yards of earth fill. Portable compressors furnished the air for the "Jackhamers" used in rock excavating and for a pneumatic digger used in clay and heavy-earth formations. In this connection it was noted that when excavating clay and heavy earth by hand methods, two laborers with picks were required to keep one mucker busy. But after the pneumatic tool was substituted, one man could keep three muckers busy.

The entire sewerage system was constructed as a joint project of the National Park Service and the Santa Fe Railway. While it was the Government's responsibility to dispose of the sewage in the park in a way so that it would not become a public menace, still it was recognized that any expense incurred in further refining the treated effluent should be borne by the railway company, because the latter was to derive most benefit from the reclaimed effluent. On this basis the cost was proportioned—the Government paying $71,992.32 and the Sante Fe Railway approximately $25,000.

All concrete structures are of a 1:2:4 mix with an addition of 10 pounds of hydrated lime for each sack of cement used. This was done to make the concrete more nearly watertight and to secure a better flow around the reinforcing steel. All concrete was heavily reinforced. The walls are of the cantilever type; and all walls common to two tanks were built to withstand pressure on either side so that any tank might safely be dewatered.

The capacity of the plant is 200,000 gallons per 24-hour day, based on a 6-hour aeration period. By decreasing the aeration period to four hours and correspondingly increasing the volume of air per cubic foot of sewage, the plant can handle 300,000 gallons daily—

Photo by Fred Harvey

Looking out upon the Grand Canyon from the interior of the observation station at Yavapai Point.

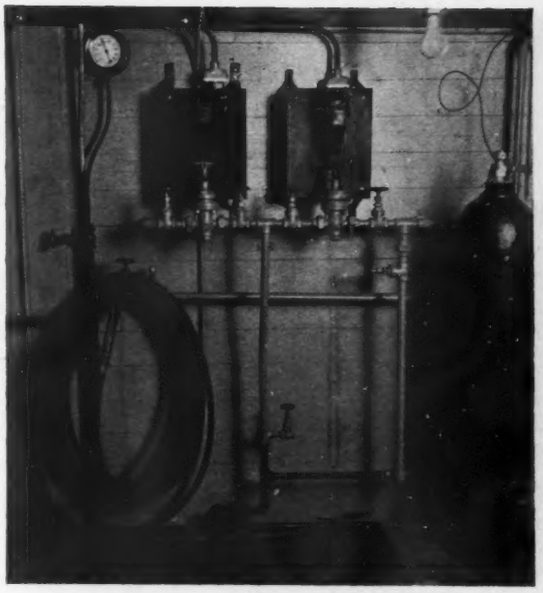
approximately three times the present peak volume.

The sewerage system was designed by Mr. H. B. Hommon, sanitary engineer for the United States Public Health Service, and the writer, at that time park engineer. Construction was done by "force account," and under the supervision of the writer assisted by Junior Engineer G. H. Carrithers, inspector and instrumentman, and "Chick" Seavey, construction foreman. The plant and laboratory is in charge of Hillard D. Hall.

Operating results have from the first been highly satisfactory. Except in the immediate vicinity of the pre-settling tank, the plant is free from any odor. The treated effluent is clear and sparkling, colorless, odorless, and tasteless. A complete chemical and bacteriological laboratory is maintained at the plant where tests are made daily of the various operations. Laboratory tests as to suspended matter indicate that the sewage is of medium strength. This is checked from time to time to determine the oxygen consumption. The low figures for ammonia content and the large percentage of nitrates indicate a high degree of nitrification. A very satisfactory stability is shown both by the low oxygen demand and by the methylene-blue test. Putrescibility tests by the methylene-blue method are made each day. The samples, however, are kept for only ten days. If the solution does not fade in that interval, the relative stability—that is, the ratio of available oxygen to the amount required to prevent putrefaction—is considered satisfactory. Samples held for that length of time without fading give by formula a relative stability of 90 per cent plus. It is interesting to note that samples have been retained for as long as six months without completely decolorizing, indicating a relative stability of approximately 100 per cent. Raw-sewage samples tested by the same method completely faded out in an average of 1½ hours.

Bacteriological analyses have always indicated a very satisfactory bacteria reduction throughout the plant. This runs from around 200,000 per cubic centimeter in the raw sewage to about 14 per cubic centimeter in the treated effluent. Bacilli Coli have in almost every case disappeared before chlorination. This cannot of course be depended upon. Consequently, the effluent is sterilized with liquid chlorine applied at the rate of an average dose of 3.6 p.p.m. at the suction of the return-line pump. Tests by the orthotolidine method are made of each clear well pumped to show the residual chlorine in the treated effluent and to make sure that there is always being applied slightly more chlorine than is necessary for complete sterilization. In no case have positive tests for Bacilli Coli been noted in the sterilized effluent.

It should be noted that although the reclaimed effluent is pumped back to the headquarters area for re-use, such re-use is, of course, strictly for non-domestic purposes—that is, for boiler make-up, cooling the jackets of Diesel motors, flushing toilets, irrigating, etc. Furthermore, all outside lines carrying reclaimed effluent are encased in vitrified split tile so that they may not be mistaken for fresh-water lines. The use of this water inside of buildings is very carefully controlled and allowed only under authority granted specifically for each separate case. When carried into buildings, the pipes are especially painted to distinguish them from fresh-water lines. In other words, every possible precaution is taken to prevent the likelihood of ever tapping one of these lines, mistaking it for a fresh-water line, and to prevent cross connecting with the drinking-water system.



Solenoid control valves of chlorinating apparatus, with a chlorine tank on scales at the right.

GANG SAWS REDUCE WASTE IN CUTTING TIMBER

AS THE result of the establishment of American Lumber Standards a few years ago, through the efforts of the Department of Commerce, numerous improvements have been made in manufacturing, seasoning, and handling lumber so as to bring the stocks up to specified standards of sizes and grades. One of the most important contributions to this end has been the introduction in the United States of the gang saw which cuts small logs, without previously squaring them, into lumber of commercial sizes. These logs, consisting of tree tops and timber cut in thinning out forest lands, have heretofore been discarded in this country.

Ever since 1916, the Department of Commerce has been investigating European sawmill practices. In consequence, there has been built in Olympia, Wash., a new mill that was especially designed for the use of gang saws—the necessary machines being provided by Scandinavian manufacturers. Since it began running in April of 1929 it has also been proved that the mill can turn out more marketable lumber from a given quantity of raw material than it has been possible to produce by any of the old-established methods. The lumber cut by the gang saws is true to size—thus doing away with the need of the sizing process by which sawn lumber is put through a surfacer to insure uniformity of dimensions.

It is interesting to note that within a few weeks after the test-mill was put in operation a company was organized in Seattle, Wash., for the purpose of manufacturing gang saws. The statement has been made that gang-sawing, if applied to the American box and crate industry, would annually save more than 100,000,000 feet of lumber that now goes to waste in the form of planer chips.

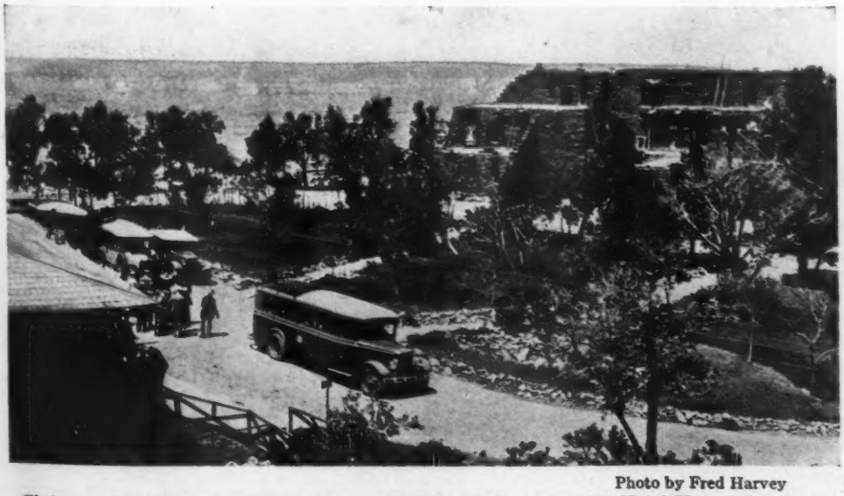


Photo by Fred Harvey

Sight-seeing buses loading in front of El Tovar Hotel, with Hopi House in the background at the right.

A western concern is said to be producing an artificial marble that resembles the natural stone in color and markings but weighs less for a given volume. The basic substance is poured into molds and, while in a plastic state, is tinted any desirable hue by the addition of coloring matter. As it comes from the molds, the cast stone has a smooth and lustrous finish and, unlike marble, requires no polishing or buffing.

Air-Driven Wire Brushes Prevent Delay in Laying a Long Pipe Line

FACED with the problem of removing heavy incrustations of rust from close on to 10,000 lengths of steel piping that he was to use in the laying of a natural-gas pipe line, a contractor turned, what had at first seemed like a staggering piece of work, into a comparatively easy one, and all because of the availability of high-speed, air-operated wire brushes. But we are getting ahead of our story.

While it is often the practice to give piping of the sort under consideration a protective coating before it leaves the mill, for a good and sufficient reason this was not done in the present case. Besides, the order had been placed months in advance of requirements, so that the pipe had to be stored out in the open where it was exposed to the corrosive action of the elements. Therefore, when the contractor, the F. G. Hoffman Company, was ready to start work on the undertaking, he had to remove the rust preparatory to painting and laying each unit, which has a length of 20 feet and an outside diameter of 8 inches.

Cleaning gangs at work removing the rust from the pipe lengths with air-operated wire brushes. Each 20-foot section was thus cleaned by two men in four minutes.

Corner of the yard where the piping for the 37½-mile natural-gas line was stored. The portable compressor at the left is supplying air to operate the radial wire brushes.

The line is being constructed for the Consumers Natural Gas & Power Company, and will extend northward for a distance of 37½ miles from Big Spring, Tex., to a point approximately fifteen miles south of Lamesa, in the same state, where it will be linked with the company's Prairie Line. But before the pneumatic wire brushes were put in service, Mr. Hoffman tried to do the cleaning with sand-blast equipment. This, however, did not prove altogether satisfactory. Apparently, the sand blast could not do the work fast enough to meet the needs of the pipe-laying gangs. Then, after experimenting with different kinds of air-operated wire brushes, it was decided that the No. 601 machine equipped with radial-type brushes was best suited for the purpose. This machine, which makes 4,200 revolutions per minute when running at full speed, is designed especially for the cleaning of rough and irregular surfaces. For the particular job in hand, which called for haste, each brush was built up of four sections with three 3/16-inch spacers between the adjoining pads so as to give the brush as wide a bearing surface as practicable.

Ten of these tools were purchased by the contractor—the necessary air being supplied by a portable compressor. With this equipment he has been able to get his material ready for laying in short order and to his complete satisfaction. By putting two men to work on each 20-foot unit, it was possible to remove the rust from the pipe at the rate of one in four minutes and to do this at a cost of two cents per foot of pipe cleaned.

ROCK DUST LESSENS EXPLOSION HAZARDS IN COAL MINES

IN proof of the fact that rock-dusting in coal mines is an effective means of saving life, the following figures have been cited by the Bureau of Mines in Information Circular No. 6178 recently published by it and covering mine explosions in the United States during the fiscal year ending June 30, 1929.

"Rock dust has been applied to a limited extent in thirteen of the 38 mines in which explosions occurred, and in six of the thirteen there is no doubt that rock dust played an important part in limiting the explosion. In these six mines 62 lives were lost, whereas 428 men were exposed to the explosions and many of them might have lost their lives if rock dust had not been applied. In one mine rock dust had been applied in the explosion area the night before the disaster occurred, and it undoubtedly stopped propagation of the flame. Four men at the point of origin were killed; but there is good reason for the belief that some or all of the other 58 lives were saved through the effectiveness of rock-dusting. It is probable that many of the 62 lives lost in the mines using rock dust would have been saved if effective rock-dusting had been practiced.

In most of these partly or imperfectly rock-dusted mines the explosion traveled through unprotected rooms, crosscuts, or trackless entries where only too many mining men think that rock-dusting is unnecessary. To be effective, rock dust must be applied to all rooms, crosscuts, and entries to within at least 40 feet of the face, as well as to all other accessible open surfaces.

The incombustible content must generally be 65 per cent or more if no gas is present; but with increasing methane a correspondingly greater percentage of incombustible is needed."

Exploring for Chromium in Montana

CHROMIUM has been described as the hardest of metals; but that by no means sums up the virtues or the distinctive characteristics of the metal, nor does it explain why a vast number of us should be interested in it.

Chromium—even in so small a measure as less than 1 per cent—is able to give to steel added strength and the capacity to resist abrasion. In addition to imparting increased toughness to steel it adds materially to the hardness of that metal. Steel so alloyed is peculiarly suited to withstand the services required of ball and roller bearings, of certain gears, and of those forms of mining and milling machinery that are subjected to rigorous stresses. Chromium, too, plays an important part in those tool steels that are now expected to cut other metals at high speed and thus save much time and money in various manufacturing stages. Needless to say, chromium steels are widely utilized in turning out quickly many of the precisely machined features of fine automobiles. But before we mention some of the other uses to which chromium is put, let us touch briefly upon its history.

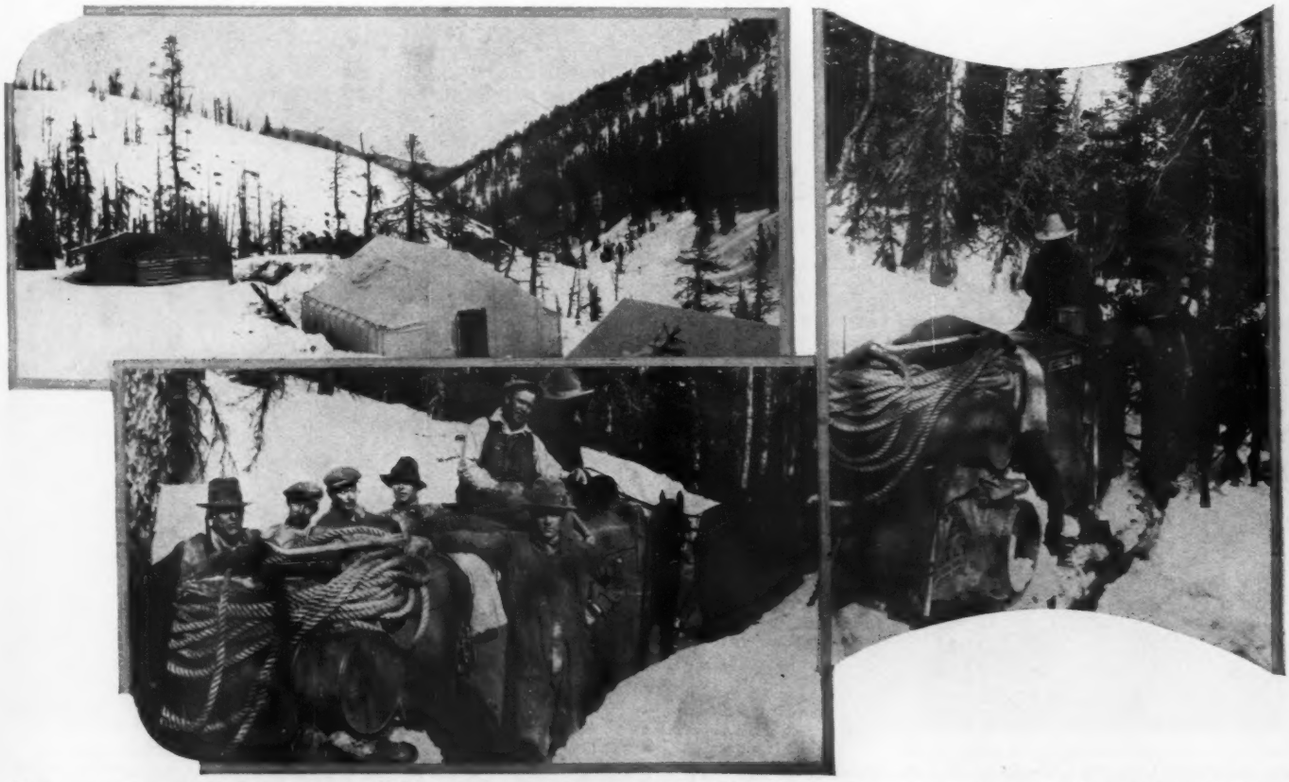
Despite the fact that chromium was discovered by a Frenchman more than 125 years ago, still it was not put to service to any marked extent until some time after 1827, when an alert youth, named Tyson, was attracted by pieces of black rock that a farmer had used to steady a cider barrel in a market place in Baltimore, Md. Tyson identified the rock as chromite ore; and, locating its source, subsequently figured in the creation of a chromite industry in this country. Chromium for decades afterwards was employed principally in the chemical industry; and it was not until around 1870 that it was utilized in the production of crucible chrome steel. In 1896, ferro-chromium was produced in an electric furnace in North Carolina. That blazed the way to a far wider employment of ferro-chromium, because by that method the alloy could be turned out with an extremely low carbon content.

Stainless steels for cutlery are resistant to oxidation because of their chromium content; and kitchen utensils and bathroom fixtures that shine like silver when treated rather indifferently owe their enduring brightness to the film of chromium with which they have been plated. Similarly, chromium plating has latterly largely supplanted nickel plating in the finishing of many of the accessories of outstanding makes of motor cars. Chromium renders various alloys proof against the corrosive attack of numerous kinds of chemicals; and, therefore, it is quite common now to so protect apparatus in chemical plants as well as to coat metal fixtures or equipment in dairies in order to safeguard milk products from contamination.

Chromium will not oxidize when heated to a high temperature; and, accordingly, it is especially useful in electric heating equipment such as toasters, waffle irons, curling irons, and percolators. As has been well said in *Research Narratives*, chromium irons and steels "are helping mankind in the fight against corrosion, filling gaps in engineering materials, and removing limitations in apparatus, machinery, and processes".

Our illustrations have to do with one of the activities of the Chromium Corporation. This American concern has been engaged in exploring a deposit of chrome ore in the southwestern part of Montana, about 44 miles from Columbus and not far from Yellowstone National Park. The property is located in the heart of extremely rough country, at an altitude of 8,000 feet, where the snowfalls are heavy and where the snow remains late in the spring because of the altitude and the protection of timber. Our pictures were taken on May 27, last year.

The mining equipment principally used in the exploratory work consisted of a 10x8-inch portable compressor; a No. 34 sharpener to condition the drill steels; a No. 6 oil furnace to heat the steels; and two S-49 "Jackhamers" equipped with JS-10 mountings, which permit them to be used for drifting. When within thirteen miles of the camp, the portable was transported on its own wheels for ten miles—the road being shoveled out in advance. Then it was put on skids and dragged the remaining three miles to the camp by fourteen horses—crossing the divide on the way at an altitude



Top—Chromium mining camp 8,000 feet up in the Rocky Mountains. Right—Here can be seen the skid upon which the 10x8-inch portable was pulled by fourteen horses a distance of ten miles over extremely rough mountain country. Bottom—Giving the horses a breathing spell before tackling the last stretch of the way that necessitated crossing the snow-clad mountains at a point 8,600 feet above the sea.

of 8,600 feet. At that time the snow lay 5 feet deep on the level in the timber. The portable arrived at the camp without mishap.

According to a mining engineer in Montana: "It is rapidly becoming standard practice out here to undertake the exploration and the early development of properties within sight of Butte, as well as at isolated places, by using portables for power plants while awaiting either the disclosure of values, which will warrant larger equipment, or the construction of foundations and buildings and the arrival of heavier equipment from the factories."

Henceforth whales are to be killed by electrocuting them, says the United States Department of Commerce. The new method is the invention of a Norwegian engineer; and it is far more humane that the age-old practice of harpooning, because the quarry dies instantly. Some of the Scandinavian whalers participating in this season's catch have been thus modernized—the necessary electrical machinery for each vessel costing around $700.

CLEANED CRANKCASE OIL USED AS FUEL

THE consumption of crankcase oil, at its source of supply, in industrial oil burners is a happy as well as an economical solution of the problem of getting rid of this waste material. When properly filtered or cleaned, it makes, we are told, an excellent fuel for heating purposes and, as such, is now employed in many large garages where thousands of gallons of the stuff are drawn from automobiles annually. True, it can be refined for reuse; but as the cost per gallon of the reclaimed oil often is nearly as much as the market price for fresh lubricating oil, the expense incurred would hardly seem to be justified.

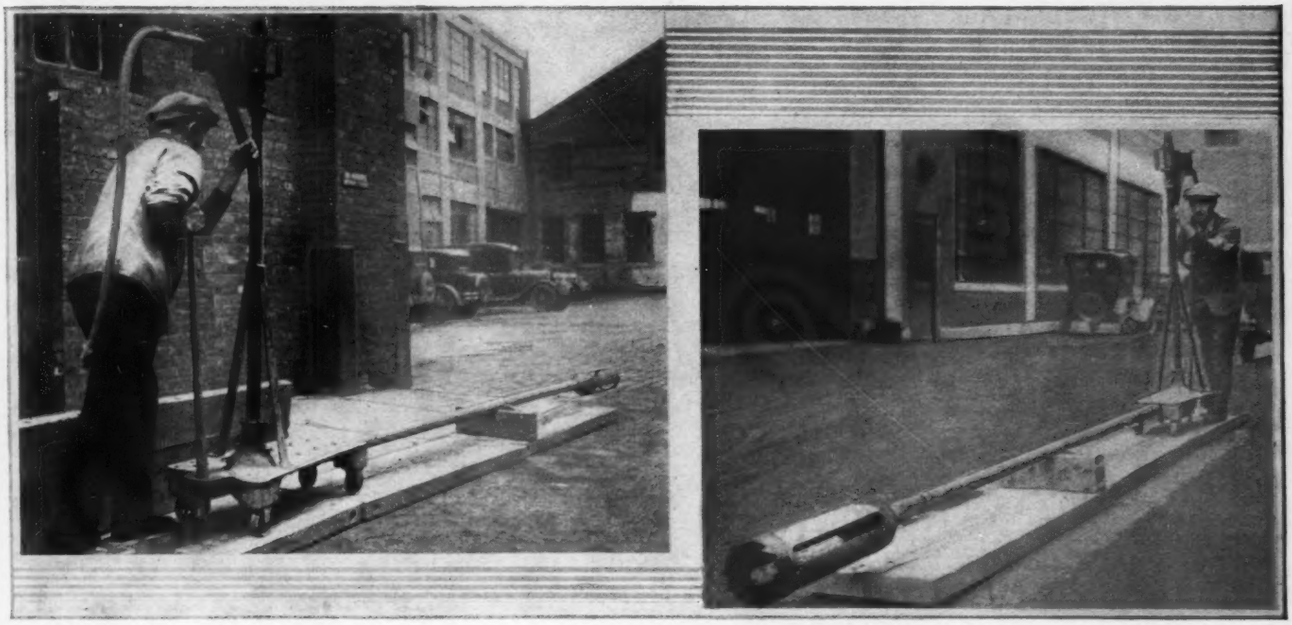
Where crankcase oil serves as a fuel, it has been found that one part crankcase oil to two or three parts of fuel oil makes a satisfactory mix. The danger of too large a proportion of gasoline is thus avoided. However, before the waste oil can be fed to the burners it must be freed of objectionable foreign matter, and for this purpose a filtering system is generally interposed between the heating plant and the storage tank. In one of these, the crankcase oil first goes into an upright tank with a cone-shaped bottom. From there it is forced by compressed air into a gravity tank, whence it flows through the filter into the fuel-oil tank that feeds the now clean oil to the burners.

Speaking of the importance of cleaning crankcase drainings before using in the manner described, the superintendent of gasoline vehicles of the Milwaukee Electric Railway & Light Company said: "We utilized about 100 barrels of drained engine oil in burners. We just dumped it into the fuel oil tanks. It would have been better to strain it, as we had some trouble with lint and carbon clogging the burners. There was no trouble from explosions or other causes."

Since 1920, Switzerland has nearly trebled her exports of electric energy. More than 1,000,000,000 kilowatt-hours, or substantially 28.4 per cent of the power generated within her borders, was used during 1928 by foreign consumers.

Ewing Galloway, New York City

The orchardist and the commercial nurseryman will probably tell you that every fruit tree is as exacting in its frequent demands for attention as a baby. Destructive creeping things that climb from the ground and harmful insects that are carried by the air or borne on wings each have to be battled with with deadly or germicidal sprays of different sorts and at separate times annually. The trees in this picture are being sprayed with an up-to-date mobile outfit of large capacity in order to treat many trees, and tall ones, without reloading. Compressed air is often employed to atomize the fluids used.



This boring tool, which is pushed forward by a lever and rotated by an air motor, obviates the tearing up of sidewalks in laying gas service pipes through clay or hardpan.

SPECIAL RIG FACILITATES LAYING OF GAS PIPES

AN ingenious pneumatic boring rig has been conceived by the Gas Dsitribution Department of the Rochester Gas & Electric Corporation that makes it possible to lay service pipes without cutting trenches the width of the sidewalk. The outfit has been in use now for some months and, according to Mr. L. H. East, assistant superintendent of that department, no trouble has been experienced in boring with it holes up to 8 inches in diameter and 24 feet long through hardpan or clay.

Our pictures plainly show the arrangement of the rig with its boring tool which carries a slotted cutter head varying from 3 to 8 inches in diameter, depending upon requirements. The forward motion of the tool is effected by a lever, while a 2½-hp. air motor furnishes the power to rotate the cutter—a Ford differential being interposed between the vertical and the horizontal driving shafts.

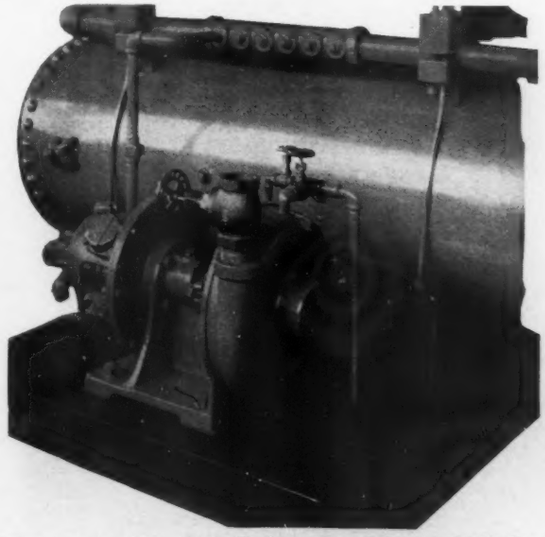
The rig is mounted on wheels and, when in use, is moved along on a special wooden runway. Down the center of this runway is secured a metal strip perforated throughout its length with holes. These serve successively as a hold for the lever when it is being applied to push the boring tool ahead.

Placed at the desired depth in a trench dug at right angles to the curb, the machine on its runway is hooked up with a nearby portable compressor that supplies the power needed to operate the air motor. The hole is driven progressively—that is, after every 2 feet of advance the tool is withdrawn and the earth in the cutter head removed. This goes on repeatedly until the hole is of the required length. It has sometimes been necessary, where hard clay was encountered, first to bore a pilot hole, about 3 inches in diameter, and then to enlarge it, to suit, with one or two reamers. This procedure has been found effective in soil containing small stones, which are worked loose in the course of operations and can be easily extracted.

AIR-OPERATED PUMP FOR FIELD USE

A SMALL air-motor-driven pump, known as the "ACV", is among the new products recently announced by the Ingersoll-Rand Company of New York City. This pump is of the Cameron, single-stage, single-suction, open-impeller, volute type, and can be conveniently carried on a shelf provided for it at the rear of a portable compressor. There is also ample room on the shelf for a tool box. The motor is of the 4-cylinder type, and obtains its air supply from the compressor. The pipe connecting the air receiver with the motor, when mounted as described, is said to interfere in no way with the operating of the pneumatic tools drawing power through hose from the same portable.

The manufacturer claims positive action for the "ACV" pump, which is designed primarily to keep excavations of one sort or another free of seepage or surface drainage while men are at work in them or to unwater flooded areas preparatory to beginning operations. When the motor is using air at 60 pounds pressure, and making 1,000 revolutions per minute, the pump is capable of handling 130 gallons of water per minute against a 29-foot head. With air at 80 pounds pressure, and when running at 1,200 revolutions per minute, the pump has a capacity of 125 gallons against a 43-foot head. These figures are based on a 20-foot suction lift.



This is one of the "ACV" air-motor-driven pumps that can be mounted on a portable compressor and perform many useful services.

The gold-bearing reefs of the Rand, in South Africa, have been mined almost without a break for a distance of 75 miles from west to east and have reached a maximum depth at the center of 7,600 feet. The underground workings throughout this area have an aggregate length of 4,000 miles, and have produced to date 200,000,000 ounces of the precious metal.

Bids have been asked by the National Advisory Committee for Aeronautics on what promises to be the largest port for seaplanes in the world. A sum of $208,000 has been appropriated by the Government for its construction at Langley Field, adjoining the Potomac River. The channel is to be approximately 2,000 feet long and 24 feet wide.

COATING CONCRETE WITH METAL

SOMETIME ago a brief mention was made in these pages of the fact that concrete was being successfully coated with metal by the Schoop process, which should require no introduction here. Confirmation of this is contained in a recent issue of the *Stone Trades Journal*, which throws more light on the subject.

The particles of molten metal, which are shot from a "pistol" under the impulse of high-pressure air, tend to fill up the pores and the surface irregularities of the concrete, thus firmly binding the metallic covering to the underlying mass. Any metal may be used, but lead recommends itself for concrete and brickwork because of its toughness and its weathering qualities.

While designed primarily to protect masonry against the harmful effects of exposure, the inner surfaces of basins, reservoirs, tunnels, etc., can be lined in this fashion to make them impermeable to and proof against the erosive action of water. Under the direction of Professor Gamba of Italy, weirs and the like were thus given a metal coating with results, so it is said, both interesting and valuable. The Swiss Society of Hydraulic Works also conducted some experiments on its own account with concrete slabs which were similar in all respects except that the controls were not lead covered. The slabs were subjected to water under high pressure—those surfaced with metal at no time showing the slightest trace of leakage.

There is nothing complex about the use of the "Homogen-pistol" by means of which the metal is applied; and a practiced worker, we are told, can satisfactorily coat 43 square feet of surface in one hour.

SOUTH DAKOTA A PROMISING SOURCE OF OIL

SOUTH Dakota is now listed as an oil producer in the United States, thus vindicating certain geologists who have for years contended that there is an abundance of oil in South Dakota, especially in the western and southern parts of the state. Sections of Fall River, Pennington, Meade, Jackson, Haakon, Hughes, Charles Mix, and Dewey counties are taking on the appearance of active oil fields; and it is predicted that great developments may be looked for in this direction in the west-river country in the next few years.

The first well to yield oil in South Dakota was the Standing Butte, 35 miles northwest of Pierre, according to the state's secretary of agriculture. This had to be abandoned when the drillers struck a flow of water of such proportions as to form a creek 25 miles long that still furnishes water, both winter and summer, for hundreds of head of stock. The newest well to be brought in is the Barker No. 1, which is located 27 miles northwest of Hot Springs. On December 31, just as 1929 was drawing to a close, the well began to gush, producing between 15 and 25 barrels hourly. The flow is increasing as the well is being carried to greater depth.

HOW GREAT CITIES ARE FED, by W. P. Hedden. An illustrated volume of 302 pages, published by D. C. Heath & Company, Boston, Mass. Price, $2.80.

THIS work is the third in the Heath Agricultural Economics Series, and answers a question that probably arises in the minds of the majority of us even though we may not give it expression. Taking the City of Greater New York as an example, it is safe to say that the citizens of no other community the world over have at their command a bigger variety and a larger dependable supply of foodstuffs the year round. This situation is not the outcome of merely fortuitous circumstances, but is the result of many contributing factors which have been coördinated to a high degree and subjected to a widespread system of regulation. Without these controlling agencies, the stream of supply would flow unevenly and lead to a deficiency at one time and to an overabundance at another—the ultimate consumer paying in either case.

As a textbook for agricultural colleges, the volume is distinguished because it is the only one devoted exclusively to the problem of city marketing; and its pages contain much new material not before made public. In short, the book tells how foodstuffs reach a metropolis, and how they are distributed and handled so as to make them available at reasonable prices to the consumer. The topic is one that should appeal to an extremely large circle of readers.

NATIONALITY, ITS NATURE AND PROBLEMS, by Bernard Joseph. A book of 380 pages, published by the Yale University Press, New Haven, Conn. Price, $3.00.

TO many, nationality is a vague term, meaning much or little according to the standard and conception of the individual, and yet nationality has played an outstanding part in the development and in the spiritual urge of substantially all peoples. After much study, the author has made a determined effort to ascertain the essential basis and the true significance of nationality. As he expresses it:

"Nationality is a force beyond the control of man and a sentiment which is deeply rooted in human nature. Any attempt to disregard its potency or deny its indispensability must be founded on a failure to apprehend the lessons of history and the nature of man. All other theories have failed dismally to furnish an adequate explanation of the proper structure of society and to appreciate and reckon with the natural mutual attraction of members of the same nationality."

The importance of the subject and the timeliness of this book rest upon the fact that one of the main constructive tasks before us in the twentieth century is to establish a new and an enduring international order. The present volume helps to clarify the problem and to make for a better understanding in approaching the attainment of so desirable a human status.

YEARBOOK OF THE AMERICAN IRON AND STEEL INSTITUTE, 1929. An illustrated volume of 476 pages, published by the American Iron and Steel Institute, New York City. Price, $5.00.

THIS book constitutes the nineteenth volume of the series containing the proceedings of the general meetings of the American Iron and Steel Institute. As usual, the yearbook presents numerous important papers dealing with different aspects of the broad field covered by the iron and the steel industries of the nation. What the steel and the iron plants of the country are doing at any period is generally recognized as a reliable index of the state or the trend of the nation's industrial prosperity as a whole. To the outsider, the Yearbook of the American Iron and Steel Institute reveals how manysided is the art and the science of producing satisfactory iron and steel so that these fundamental metals can be made suitable and turned out in ample quantities to meet the ever-increasing demand for them. The current yearbook does not differ in this respect from those that have gone before it. It contains many worth-while papers.

TRANSACTIONS OF THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS, 1929. An illustrated volume of 410 pages, published by The Institute, New York City. Price, $5.00.

THE papers printed in the current volume were read during 1929. They relate to metal mining, to non-ferrous metallurgy, to non-metallic minerals, and to mining geology. All told, nineteen papers are reproduced, and they contain much informative material. The topics dealt with include cycles in metal production, air-conditioning in deep mines, Government potash explorations in Texas and New Mexico, clay mining for quality, origin of iron ores of Iron Mountain and Pilot Knob, Mo., etc., etc.

Oxwelded Construction for Modern Piping Services is the title of a booklet recently issued by The Linde Air Products Company, New York City. This profusely illustrated publication discloses some of the very many ways in which oxy-acetylene is now utilized in welding piping for a multiplicity of purposes. This booklet is both suggestive and informative, and should prove an aid to numerous persons.